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REMEDIAL READING AT  
THE COLLEGE AND ADULT  
LEVELS \* *An Experimental Study*

By G. T. BUSWELL

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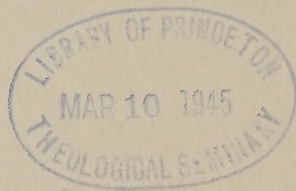
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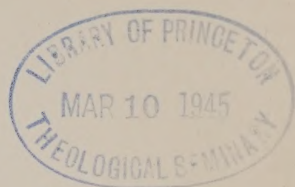




**REMEDIAL READING AT THE  
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SUPPLEMENTARY EDUCATIONAL MONOGRAPHS  
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# Remedial Reading at the College and Adult Levels

*An Experimental Study*



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NUMBER 50 \* NOVEMBER 1939

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G. T. B.



TABLE OF CONTENTS

	PAGE
LIST OF PLATES . . . . .	ix
LIST OF TABLES . . . . .	xi
CHAPTER	
I. INTRODUCTION . . . . .	I
II. PROBLEM AND TECHNIQUE . . . . .	8
III. PRELIMINARY EXPERIMENTS . . . . .	31
IV. RESULTS OF REMEDIAL PROGRAM WITH FINAL EXPERIMENTAL GROUPS	34
V. INTERPRETATIONS . . . . .	56
VI. EXTENSIONS OF THE STUDY . . . . .	67
INDEX . . . . .	71





## LIST OF PLATES

PLATE	PAGE
I. EASY MATERIAL USED FOR EYE-MOVEMENT RECORDS—SELECTION A	20
II. EASY MATERIAL USED FOR EYE-MOVEMENT RECORDS—SELECTION B	21
III. DIFFICULT MATERIAL USED FOR EYE-MOVEMENT RECORDS—SELECTIONS A AND B . . . . .	22
IV. FILM PROJECTOR USED IN READING EXPERIMENT . . . . .	23
V. (A) CAMERA USED TO PHOTOGRAPH READING MATERIAL FOR USE IN FILM PROJECTOR. (B) SAMPLE OF FILM USED IN READING PROJECTOR . . . . .	24
VI. APPARATUS FOR PHOTOGRAPHING READING MATERIAL FOR FILM PROJECTOR . . . . .	25
VII. APPARATUS FOR COVERING READING MATERIAL AT A CONTROLLED RATE . . . . .	68





## LIST OF TABLES

TABLE	PAGE
1. SUBJECTS USED IN READING INVESTIGATION . . . . .	17
2. READING MATERIALS USED WITH THE FILM PROJECTOR . . . . .	26
3. EFFECT OF REMEDIAL PROGRAM AS MEASURED BY PRESSEY'S TEST OF READING SPEED AND COMPREHENSION . . . . .	35
4. EFFECT OF REMEDIAL PROGRAM ON (1) SPAN OF RECOGNITION, (2) REDUC- TION OF REGRESSIVE MOVEMENTS, (3) SPEED OF RECOGNITION, AND (4) RATE OF READING AS MEASURED BY EYE-MOVEMENT RECORDS . . . . .	37
5. MEDIAN GAINS, IN PERCENTAGES, OF RAPID, MEDIUM, AND SLOW READERS IN GROUPS I-III IN (1) SPAN OF RECOGNITION, (2) REDUC- TION OF REGRESSIVE MOVEMENTS, (3) SPEED OF RECOGNITION, AND (4) RATE OF READING AS MEASURED BY EYE-MOVEMENT RECORDS . . . . .	46
6. COMPARISON, IN GROUP MEDIANS, OF EYE-MOVEMENTS AND RATE OF READING OF TWENTY-ONE SUBJECTS ON TWO TESTS TAKEN AT AN IN- TERVAL OF ONE MONTH WITHOUT INTERVENING TRAINING . . . . .	50
7. RETESTS OF EYE-MOVEMENTS SHOWING MAINTENANCE IN (1) SPAN OF RECOGNITION, (2) REDUCTION OF REGRESSIVE MOVEMENTS, (3) SPEED OF RECOGNITION, AND (4) RATE OF READING . . . . .	52
8. COMPARISON OF MEDIANS FOR SIXTEEN SUBJECTS HAVING VISUAL DEFECTS WITH MEDIANS FOR GROUPS I-III COMBINED . . . . .	54



## CHAPTER I

### INTRODUCTION

UNTIL the last decade the teaching of reading has been very generally considered a problem of the elementary school. Having completed the eighth grade, the child, it was assumed, was able to read. High schools and colleges showed no concern about the reading ability of their students; indeed, they frequently listened with disdain to the suggestion that the improvement of reading ability might be considered one of their legitimate objectives.

During the last few years a marked shift of interest has taken place. In fact, the improvement of reading of high-school and college students is now frequently approached with more enthusiasm than understanding, and the inevitable tendency to exploit a new educational trend is already apparent. The years 1930-39 have witnessed the publication of numerous scientific studies and of even more exercise books and practical aids for improving the reading abilities of high-school pupils and of adults. Increased interest in the teaching of reading is noticeable in schools at all levels. For example, during the summer of 1938 the University of Chicago announced a conference on reading with the expectation that between 250 and 300 teachers might attend. The conference opened with an enrolment of 900 teachers coming from a wide geographical area and representing a range of schools from the primary grades through the college. During the summer of 1939 more than 70 conferences on reading were conducted in the United States.

To meet this widespread interest in reading, a substantial body of scientific knowledge is needed to give direction to the remedial work being undertaken. The literature on remedial reading is extremely varied in character. There is a limited amount of verified scientific knowledge upon which a program of remedial reading can be based. However, there exists a much larger body of quasi-scientific or pseudoscientific literature so varied in character as to be confusing to a director or supervisor of reading. When an investigator



analyzes the entire mass of literature relating to the teaching of reading, he finds that some basic factors have been identified, around which important remedial techniques have been developed, but that many trivial techniques and devices have been suggested, unconfirmed by any data and supported only by a claim that, if tried, they would be useful. The teacher of reading experiences great difficulty in deriving from the literature a set of workable techniques for improving the reading ability of pupils at different levels.

The study reported in this monograph is concerned entirely with the *process* of reading, which obviously is only a part of the total problem of teaching reading. The exclusion from consideration of such matters as materials of reading, purposes of reading, and sociological data relating to types of readers and kinds of material read carries no implication that these factors are of less importance. Limiting the problem is simply a recognition of the fact that, to be effective, any scientific study must be focalized.

A study of the reading *process* is concerned particularly with the question of *how* one reads. An analysis of the "how" of the reading process reveals special aspects of the problem.

First, reading involves mental concentration on what is read. Mind-wandering is one of the worst enemies of effective reading. The causes of lack of concentration need further study. Are the factors which produce this deterrent to good reading inherent in the material read, in its style, in the interests of the reader, in his present knowledge of the subject in which the reading falls, or in the nature of the process by which he reads? What are effective methods of eliminating mind-wandering?

Second, there is the question of just how one translates visual impressions of printed symbols into meanings. The perceptual aspect of this process is sometimes referred to as the "mechanics" of reading, but certainly no psychologist would describe this transition from visual impression to meaning as mechanical. In the teaching of reading the use of the word "mechanics" has been extremely unfortunate because of the customary contempt for anything mechanical as compared with the high respect for anything involving understanding or meaning. There is, in the process of reading, no duality which permits separation of the total reading act into purely physi-

cal parts as contrasted with other purely intellectual parts. The unfortunate result of treating the perceptual processes in reading as though they were mechanical is that many individuals pass through the elementary-school years without learning effective reading habits. They are hurried on to levels of critical reading without having developed those factors of the reading process which are basic to effective reading of any kind, simple or complex. Consequently, at both the high-school and the college levels persons are found who read even simple material less effectively than do good readers in the sixth grade of the elementary school. The writer has often encountered graduate students whose habits of reading were so ineffective that they read ordinary material, involving no special difficulties in either vocabulary or in ideas, at a rate of less than 250 words a minute. Their perceptual habits showed crudities which typically are found in the middle grades. Yet with these handicaps they ambitiously attempted graduate work, only to find themselves constantly frustrated by their lack of reading ability.

The present study is concerned directly with the possibility of improving a small group of factors basic to the reading process. It deals with individuals above the elementary-school level. Furthermore, it deals with the reading problem in the light of practical complications and limitations which must be recognized when dealing with mature persons. Important as it may be to possess superior reading habits, few high-school pupils or adults would willingly drop all other work for a year to learn to read more effectively. In fact, it is difficult to find adults who are willing to devote to this purpose even a small part of their time for a period as short as three months. This study, therefore, has attempted to find what can be done during a period of one month in which an individual gives an hour a day for five days a week to an intensive effort to improve his reading ability.

Any individual obviously does different kinds of reading under different circumstances. For example, the morning newspaper is not read in the same way as is a nonfiction book. Assignments for collateral reading in high school or college do not necessitate the kind of reading required by textbooks. A person does not read gems of

literary style in the same manner as he reads a legal contract to which he must affix his signature. Any method of teaching reading should strive for flexibility sufficient to permit the process to be adapted readily to the specific material and particular purpose.

The present study has intentionally excluded several important types of reading. It does not deal with reading where analysis and criticism are the principal characteristics. For some people, and at certain times for everyone, this type of reading is of the highest importance. It involves a process different from that employed in simple, straightforward reading where both vocabulary and structure are within the easy range of the reader and where the ideas expressed are so clear that ambiguity seldom occurs. For example, let the reader try to read the following five samples in whatever manner is necessary to enable him to give, after completing each sample, a brief statement setting forth the meaning of the paragraph in his own words.

#### SAMPLE A

The Falcon, a squat ship built close to the water like a mine sweeper, arrived at dawn from New London, Conn., the navy's submarine base, and immediately began preparations for the rescue. It formed the busy center of a ring of ships that stood by for salvage and rescue duty. The sea and weather co-operated in the rescue work. After a choppy night and rainy morning the water subsided to a calm and the sun shone.

Shortly after 10 A.M. a diver made the perilous descent to the bottom and made fast a chain to the escape hatch. At the other end of the chain, on the afterdeck of the Falcon, stood the rescue bell waiting to be lowered.<sup>1</sup>

#### SAMPLE B

We no longer have the frontier to divert us or to absorb our energies. We shall steadily become a more densely populated country in which our social ideals will have to be such as to give us civilized contentment. To clear the muddle in which our education is at present, we shall obviously have to define our values. Unless we can agree on what the values in life are, we clearly can have no goal in education, and if we have no goal, the discussion of methods is merely futile. Once the frontier stage is passed—the acquisition of a bare living, and the setting-up of a fair economic base—the American dream itself opens all sorts of questions as to values. It is easy to say a better and richer life for all men, but what *is* better and what *is* richer?<sup>2</sup>

<sup>1</sup> *Chicago Daily News*, May 24, 1939.

<sup>2</sup> James Truslow Adams, *The Epic of America*, p. 407. Boston: Little, Brown & Co., 1931.



## SAMPLE C

Man's resources are the causalities inherent in things. When anything whatever is to be accomplished, causalities have to be invoked that make no concession to vision. That is only to say that they can be depended upon. To put into operation causalities that will generate specific results is the aim both of the man who plants a potato and of the man who seeks to reform the state. Causality is bound to operate in any case, and intelligence will see to it that, so far as possible, the causalities that operate are the causalities of its choice. Only thus can there be a technique for generating a chosen future out of a given present.<sup>3</sup>

## SAMPLE D

But with respect to statements in a contract descriptive of the subject-matter of it, or of some material incident thereof, the true doctrine, established by principle as well as authority, appears to be, generally speaking, that, if such descriptive statement was intended to be a substantive part of the contract, it is to be regarded as a warranty; that is to say, a condition on the failure or non-performance of which the other party may, if he is so minded, repudiate the contract in toto, and so be relieved from performing his part of it, provided it has not been partially executed in his favor. If, indeed, he has received the whole or any substantial part of the consideration for the promise on his part, the warranty loses the character of a condition, or, to speak perhaps more properly, ceases to be available as a condition, and becomes a warranty in the narrower sense of the word, viz. a stipulation by way of agreement, for the breach of which a compensation must be sought in damages.<sup>4</sup>

## SAMPLE E

Cretaceous bird, your giant claw no lime  
 From bark of holly bruised or mistletoe  
 Could have arrested, could have held you so  
 Through fifty million years of jostling time;  
 Yet cradled with you in the catholic slime  
 Of the young ocean's tepid lapse and flow  
 Slumbered an agent, weak in embryo,  
 Should grip you straitly, in its sinewy prime.  
 What bright collision in the zodiac brews,  
 What mischief dimples at the planet's core  
 For shark, for python, for the dove that coos  
 Under the leaves?—what frosty fate's in store  
 For the warm blood of man,—man, out of ooze  
 But lately crawled, and climbing up the shore?<sup>5</sup>

<sup>3</sup> Wendell T. Bush, "The Emancipation of Intelligence," *Journal of Philosophy*, VIII (March 30, 1911), 178.

<sup>4</sup> William L. Clark, Jr., *Handbook of the Law of Contracts* (Second edition by Francis B. Tiffany), p. 211. St. Paul, Minnesota: West Publishing Co., 1904.

<sup>5</sup> From *Wine from These Grapes*, p. 61. Published by Harper & Brothers. Copyright, 1934, by Edna St. Vincent Millay.

The foregoing exercise illustrates the fact that the process of reading must vary according to the purpose and the content of the material read. The present study is limited to materials similar to Samples A and B for two reasons: (1) Material of this kind makes up the great bulk of the reading done by most persons, and (2) ability to read such material effectively is basic to any other type of reading.

One of the primary requirements of ability to read is a degree of flexibility which permits adapting the process of reading to various kinds of reading situations. The nature of this flexibility is so important that it deserves special consideration. It is a psychological phenomenon which is characteristic of many types of behavior. To understand this form of adaptation, one must recognize that flexibility is a mature form of experience and that it never characterizes the performance of the novice no matter what the situation. Flexible adaptation is a process of modifying a type of performance already acquired in some degree. This point is often misunderstood. Flexibility which grows out of a mastery of the basic elements of a performance gives a high degree of adaptability. An attempt to make these adaptations before the basic elements of performance are mastered results in specialized and unintegrated behavior which inhibits adaptation to changing situations.

As related to the teaching of reading, the psychology of flexibility implies that a pupil should learn to read simple, straightforward material with a high degree of efficiency before the reading process is allowed to crystallize. There is ample evidence to indicate that, by the sixth grade of the elementary school, children can master the basic factors of the reading process so well that, for material within their range of experience and within their vocabulary, they can read with as much speed and with as full understanding as adults can read the same kind of material. While the evidence is clear that the majority of children can, with good methods of teaching, reach this degree of proficiency by the end of the sixth school grade, the evidence is equally clear that a large number of pupils are passed on to the high school without having mastered reading to this extent. Without having mastered the basic process of reading, they are plunged into new reading situations which so interrupt and interfere with the development of important reading habits that their process

of reading is crystallized at a level below that which should be reached. Readers of this type make up the load of remedial teaching in high school and in college. Not only are they unable to adjust their reading habits to the variable demands of the high-school and the college programs, but they are also unable to read efficiently even when vocabulary and content are simple. They have not learned how to translate the perception of printed symbols into meaningful experiences with rapidity and with absence of any feeling of difficulty. This ability is the first objective of the teaching of reading and, likewise, is the most necessary point of attack for any helpful remedial program.

Of the various factors which make up silent reading, the writer has selected five which are recognized as among the most important affecting reading ability. These five factors will be discussed in detail in the following chapter.

## CHAPTER II

### PROBLEM AND TECHNIQUE

THE present study is concerned with an integration of some of the important factors which make up the reading process. Although the term "integration" has been much abused in educational literature, it is a most useful psychological concept. It has often been used as the antithesis of the term "analysis," and writers have spoken of an "integrated approach" in contrast with an "analytical approach" to a problem. Psychologically there is no incompatibility between these two terms.

The purpose of this study is to discover whether certain factors, which are known to be important elements of the reading process, can be integrated into a reasonably simple but effective remedial program. As anyone familiar with the literature on remedial reading knows, the essentials to such a program are often lost in an accompanying mass of trivial procedures. It may be that many of the suggested techniques are good, but certainly all are not equally good.

### FACTORS TO BE STUDIED

This study is an experiment to determine the possibility of achieving the following five objectives, which seem essential to the improvement of the reading process: (1) the elimination of vocalization in silent reading, (2) an improved mastery of vocabulary, (3) a broadening of the span of recognition, (4) an increase in the speed of recognition, (5) the development of a degree of regularity of procedure that would eliminate most of the regressive movements of the eyes.

These five factors have already been studied in some detail, and a large body of knowledge relating to them is available. Whatever additional contribution this study may make consists in the integration of these factors into a remedial program focused upon specific objectives and restricted to a relatively short period of time. The reasons for selecting these particular factors will be discussed briefly before an account of the experiment is given.

*Vocalization.*—Oral reading, which in former years monopolized almost the entire time of the reading program in the elementary school, still persists to a far greater degree than many persons realize. The writer is not proposing the complete elimination of oral reading from the school program, for it has legitimate values. On the other hand, one of the undesirable outcomes of early training in oral reading is a habit of vocalizing, which frequently carries over into the silent-reading process and causes attention to be focused upon words rather than upon ideas. This problem is not limited to cases where vocalization is so obvious as to produce lip movement or noticeable contraction of the throat muscles. It affects a far larger number of cases where the movements may be too small for observation but where the reader is conscious of attention to each word. Another undesirable result of vocalization is that reading is necessarily slowed down to the speed at which words can be pronounced. For most persons the result is a rate of less than 200 words a minute. It is rare indeed to find a reader who can vocalize at more than 250 words a minute. Consequently vocalization is the natural accompaniment to slow reading, and with slow reading come other undesirable habits. One of these is a habit of mind-wandering, which occurs because the rate of reading is so much slower than the individual's ordinary rate of thinking that he attempts to carry on two processes at the same time, with obvious disadvantages to reading. Still another undesirable result of vocalization is that it focuses attention on word elements and prevents the fusing of words into wider units of meaning. In reading, understanding does not consist in summing up the meanings of individual words but rather in the fusing of words into patterns which stand for ideas.

Although, in general, vocalization is an undesirable habit, an understanding of its genesis reveals that it can be useful at certain times. Vocalization in reading is somewhat like thinking aloud. When the material in reading becomes extremely difficult, one tends to go back to a primitive habit of vocalizing just as, when a problem in thinking is too hard, a person may find himself thinking aloud. For some types of material and for certain purposes, or at times when the reader is extremely fatigued, vocalization may serve a useful end. Here again the principle of flexibility must be recognized, although



in the great majority of cases the habit of vocalizing is a deterrent to good reading and should be eliminated.

*Vocabulary.*—Effects of vocabulary difficulties upon the reading process have perhaps been revealed most clearly by the eye-movement studies. These have repeatedly shown, in completely objective fashion, that unfamiliar words interrupt the smooth flow of ideas and necessitate an analysis of the word causing the difficulty. This analysis is revealed in the eye-movement photographs by a series of oscillating eye-movements which cover the word in more or less complete detail. A more adequate mastery of vocabulary is a highly desirable contribution to the reading process.

Vocabulary has probably been studied as much as, or more than, any other single topic relating to reading. One result of these studies was the development of vocabulary lists, such as those of Thorndike and Gates, which have been of great value in grading reading materials. Vocabulary lists have not always been wisely used and have sometimes resulted in a paucity of vocabulary, but usually their effects have been beneficial. More recent vocabulary studies have extended these lists in a desirable direction. They have recognized that a word may have a variety of meanings and have attempted to tabulate the commonness of the word in respect to each meaning rather than to group all meanings together. These data have proved to be a great help in grading vocabularies for reading materials.

The understanding of vocabulary difficulties has proceeded in still other directions. Educators now rather generally recognize that a word is a product of experience, and that its connotation cannot be mastered by simply looking up its meaning in a dictionary. This realization has had an enormous influence on the reading programs in elementary schools. It has emphasized the importance of providing a breadth of experience and an abundance of ideas gained outside books for the sake of what these bring to an understanding of what is read. Because an enlargement of vocabulary must grow from experience, vicarious or direct, it is difficult to add to a person's vocabulary in the limited amount of time devoted to a remedial program. Consequently in such a program emphasis should probably be given to the intensive study of word meanings as contrasted with breadth of vocabulary development.

A study of precise meanings may be approached through an attempt to improve the general understanding of language, which is obviously essential to good reading. For this reason the attack on vocabulary in the present study consisted in an attempt to build up an understanding of those general characteristics of language which apply broadly to many words. For example, attention was given to the study of prefixes, suffixes, and word roots on the ground that, if these are mastered in general principle, the recognition and understanding of many words will thereby be aided.

*Span of recognition.*—Reading is a process of getting meaning from conventional printed symbols. It is a form of visual perception; and the method of learning to read follows the same general pattern as does the development of other forms of visual experience using conventional and abstract symbols.

The perception of a new word or phrase requires a detailed examination, but with increasing familiarity a satisfactory response will result from a brief observation of the barest outline of the letters or the words. In fact, the more proficient one is in reading, the less attention one gives to minor details of the material read and the broader the span of recognition becomes. This fact is particularly apparent when a rapid reader tries to do proofreading.

A broad span of recognition is necessary for rapid reading. Furthermore, it facilitates comprehension by releasing the mind from attention to minor details of form and thereby permitting a fusion of letters and words into thought patterns. The objective of good reading is to release the mind from any conscious attention to letters and words as such and to permit it to deal entirely with the expanding sequence of meaning. As the reader becomes more and more free from the requirements of detailed visual perception, he experiences a greater and greater degree of absorption in the meaning of the material read. Reading then proceeds without awareness of perceptual effort until some special difficulty of word or meaning interrupts the train of thought. While an almost complete freedom from perceptual load can be accomplished by the competent reader, this degree of facility is found only in a small percentage of cases. Most readers are only partly free from perceptual difficulties, and, among the students who make up remedial classes in high schools and colleges, the purely

perceptual difficulties bulk large. They are identified by a narrow span of recognition as revealed by eye-movement photographs, which supply objective evidence that the individual is unable to recognize several words with a single fixation but is analyzing the material in detail as would be done by children in the middle grades.

Because of the confusion in some of the literature in regard to enlarging the span of recognition, it is highly important that teachers understand the situation clearly. The assumption all too frequently encountered, namely, that physiological exercises in which eye-movements are produced by sweeping the eye across a series of dots or lines will increase span of recognition, misses the point entirely. Of course, reading involves peripheral adjustments through eye-movements, but training eye-movements does not increase reading ability. Neither does the correction of visual defects, in itself, improve reading. This type of work may rightly be described as "mechanics" and has brought to the term "mechanics" the deserved contempt which many people feel for it.

The exploiting of machines and gadgets by persons who do not understand the psychology of reading seems at present to be adding greatly to this mechanistic folly. Because the span of recognition can be measured objectively by photographing eye-movements, it does not follow that by stimulating eye-movements mechanically a wider span of recognition in reading can be developed. Amateurish practices of this kind should not be permitted to discredit scientific techniques which, when used legitimately, possess real value. Furthermore, a clear distinction should be made between methods of teaching reading which eventuate in the development of a broad span of recognition such as normally accompanies efficient reading and methods which attempt to gain the same end by a purely mechanical control of muscular reactions. Certain forms of apparatus may be useful in stimulating a type of reading which will result in a broad span of recognition. However, apparatus can never be a substitute for educational theory; it only implements educational theory at certain points.

Developing a broader span of recognition as a part of the reading process is a significant contribution to improving reading. It is for this reason that span of recognition has been accepted as one of the specific factors for study in the present investigation.

*Speed of recognition.*—By “speed of recognition” the writer means the time required for recognition during a single pause of the eye. The measure of speed of recognition is the average duration per fixation pause. This factor is admittedly difficult to modify, and all previous studies have shown that speed of perception yields but slowly to training.

The duration of the pauses of the eye while a subject is reading are not subject to voluntary control. They are the products of the unconscious demands of recognition. Difficulty always increases the duration of the pauses, while familiarity reduces it. For a particular individual reading a given kind of material the duration of pauses is not at all uniform. Also, the average duration of fixations shows variation from subject to subject, being shorter for the better readers and longer for the poorer ones. The process of learning to read in the elementary school is accompanied by a steady diminution in the duration of pauses. This diminution proceeds rapidly during the first five school years, then with less acceleration as reading habits crystallize.

The rate of reading is a function of the number of fixations and the average duration of fixations. Rate of reading can be increased by reducing the number of fixations per line, by reducing the average time per fixation, or by reducing both. The correlation between number of fixations and duration of fixations is positive and fairly high. Those individuals who make the most fixations per line make the longest fixations; those who read with a wider span of recognition have shorter pauses. For the reading of a 92-word selection by 907 adults examined in the writer's laboratory, the correlation between average number of fixations per line and average duration of fixations was  $+ .71$ . This correlation is significant for the development of reading ability, since it means that those characteristics of reading which produce a wide span of recognition also produce rapid recognition and that the two factors operate in support of each other rather than as compensating elements. Consequently, developing a more rapid rate of reading may be expected to benefit the whole process. Although it is difficult to produce large changes in the average duration of fixation, any improvement in quickness of recognition is a direct way to increase rate, and a change of as little as 5 or 10 per cent produces a very large saving of time in a year's reading.



*Regularity of procedure in reading.*—The rate of reading of a typical individual varies from page to page. One who sits in a library and with a stop watch times the intervals at which a reader turns the pages of a book, finds that the amount of time devoted to successive pages is far from uniform. There is no reason to expect mathematical precision in the amount of time devoted to successive pages. In fact, for certain types of material and for certain purposes of reading, one could defend a considerable variation in time. However, if most reading material is examined page by page in relation to the amount of time normally required for each page, no stretch of the imagination can justify spending so much time on some pages as compared with the amount spent on others of the same book. A hypothesis of variation due to mind-wandering fits many of these cases far better than a hypothesis of variation due to critical thinking during the reading process. Such page-by-page comparison can be refined by making line-by-line comparisons from the data afforded in an eye-movement photograph. Here one frequently finds the same lack of regularity. Much variation occurs both in time and in number of fixations required to read successive lines, particularly among poor readers.

The writer does not propose that the number of fixations per line or the total time per line should show anything like perfect uniformity. He is prepared to defend the statement that there should be a reasonable amount of uniformity, and, furthermore, he can present evidence to show that with good readers the degree of uniformity is fairly high.

There are many perceptual situations outside the reading process which support the hypothesis that a fair degree of uniformity in reading similar material might be expected. When a thousand persons sit in an audience listening to a lecturer, the auditory perceptions of all proceed at the same rate. Each listener adjusts his own comfort and convenience to the rate at which the speaker proceeds. Within broad limits audiences are able to adjust themselves to either very rapid or very slow speech. In this case of auditory perception it is clear that individuals can make adjustments to the demands of the situation. Good rhythm of expression is admittedly a great aid to ease of listening. However, even the rhythm adopted by different



speakers using the same words shows wide variation. People accustom themselves to listening at the rate demanded in a co-operative social situation and apparently succeed in doing critical thinking at the same time.

Psychologically the situation in reading is not basically different from listening to a speech. The stimuli come in through the eye instead of through the ear, and there is the same possibility, within the limits accepted by common sense, of a fair degree of uniformity in covering the lines. However, in reading there is no outside pressure to determine the rate at which one receives perceptual stimulation. The reader sets his own standards. As a result some persons, when reading, keep their minds active and, by concentrating on the material at hand, proceed fairly regularly line after line. Others show an extreme variability, reading rapidly for a time, then letting their minds wander as they slow down. In still other cases regularity is necessarily impossible because perceptual habits are so poorly developed that frequent re-examination by means of regressive movements is necessary before the material is recognized. These regressive movements of the eyes become the best objective index of the degree of regularity in moving ahead while reading.

A large body of data is now available relating to regressive movements. These data show that regressive movements are extremely common with immature readers but that they gradually diminish as proficiency increases. For material at the reader's level of experience, the number of regressive movements found among high-school pupils is small. If the difficulty of the material is increased, the number of regressions immediately reflects this change. Regressions are affected by level of reading ability, by difficulties either in vocabulary or in thought, by purposes of reading, and by the nature of the material read. In the ordinary reading of newspapers and magazines one should expect to find few backward movements. In the reading of a legal document to which a signature must be affixed, many more regressive movements are likely to occur. The important fact to note, however, is that, for any given type of material or for any given purpose of reading, the better readers make fewer regressive movements than the poorer readers. Regressive movements always reflect difficulty; few, if any, occur where there is no difficulty.

The reduction of regressive movements is taken as the fifth objective in the present study. If regressive movements can be eliminated by proper remedial techniques, the reader will profit from a degree of regularity compatible with, and assisting in, a continuous fusion of words into units of meaning.

#### THE REMEDIAL EXPERIMENT

In a series of remedial experiments reported in an earlier monograph,<sup>1</sup> the writer found that the remedial techniques used could not be applied successfully to groups. In those experiments the number of persons in the groups varied from seven to twenty-two, but even in the smaller groups the individual variations from member to member were so large that it was impractical to have them read as groups. When the material to be read was presented to a group at a rate comparable to the average ability of its members, the rapid readers received no stimulation and were actually slowed down to some extent, whereas the slower readers soon became lost in trying to reach the group speed. In the present experiment the number of subjects present in the laboratory at any one time varied from four to eight, but they received practice and were tested individually.

Each subject came to the laboratory for a fifty-minute period five days a week for four weeks. In general the periods were divided as follows: first, twenty-five minutes of reading with the rate controlled by a film projector which will be described presently; second, fifteen minutes of study and exercises on vocabulary material designed to give a general method for attacking new words; finally, ten minutes used for making laboratory records, administering progress tests, and giving general instructions relating to the individual's needs.

*Subjects used.*—The subjects used in the experiment ranged from Freshman college students to adults not attending any school. In the entire experiment 128 subjects were used. One hundred and seven of these went through the remedial procedures. An additional group of 21 subjects were given eye-movement tests at the beginning and the end of a four-week period but did not have any intervening remedial treatment, thereby serving as a control group for certain factors in the experiment.

<sup>1</sup> G. T. Buswell, *How Adults Read*. Supplementary Educational Monographs, No. 45. Chicago: Department of Education, University of Chicago, 1937.

The 107 subjects in the remedial group were divided into eight subgroups. Four of these subgroups, including 29 subjects, were considered as preliminary cases and were used for experimenting with the techniques and for checking and improving the remedial methods. These preliminary groups are designated as Groups A, B, C, and D. The remaining 78 subjects were likewise divided into four groups and in the report are designated as Groups I, II, III, and IV.

TABLE 1  
SUBJECTS USED IN READING INVESTIGATION

GROUP	TOTAL NUMBER OF SUBJECTS	CLASSIFICATION OF SUBJECTS		DATES OF REMEDIAL TREATMENT	
		Students	Non- students	Beginning	End
Preliminary subjects:					
Group A.....	7	5	2	4- 4-38	4-29-38
Group B.....	8	3	5	5- 2-38	5-27-38
Group C.....	7	3	4	6-27-38	7-22-38
Group D.....	7	6	1	7-25-38	8-18-38
Total.....	29	17	12	.....	.....
Experimental subjects:					
Group I.....	20	14	6	10- 6-38	11- 3-38
Group II.....	20	19	1	11- 7-38	12- 2-38
Group III.....	25	19	6	1- 9-39	2- 3-39
Group IV.....	13	11	2	3-20-39	4-14-39
Total.....	78	63	15	.....	.....
Control subjects.....	21	21	.....	2- 9-39	3-13-39
Grand total.....	128	101	27	.....	.....

and IV. Groups I, II, and III, and IV followed identical procedures except that Group IV did not use the film projector. Instead of using the film projector, the subjects in Group IV read directly from printed sheets with the beat of the metronome acting as a stimulus to control their rate of reading. The number of subjects in each group and the dates for beginning and ending the remedial exercises are shown in Table 1.

*Materials used.*—For Groups A, B, C, and D there was a progressive modification of materials to be described in chapter iii, which deals with the preliminary experiments. Both the film materials and

the vocabulary materials were developed during this part of the study, and consequently they varied somewhat from group to group.

For the final experiment, which was carried on with Groups I, II, III, and IV, the materials used may be described under four headings: (1) tests, (2) eye-movement films, (3) vocabulary exercises, and (4) miscellaneous reading materials.

Two standardized tests of reading were used as well as some unstandardized testing materials. For measuring rate and comprehension S. L. Pressey's Test of Reading Speed and Comprehension was used. The Pressey test was divided into two halves, the first half being given at the beginning of the experiment and the second half at the end. The comprehension questions on this test were divided and given according to the same plan. The Nelson-Denny Reading Test for Colleges and Senior High Schools was used to measure the results from the vocabulary exercises.

Two levels of material were used for measuring changes in eye-movement habits. Two paragraphs of easy reading material were selected from the sixth reader of "The Children's Bookshelf," edited by B. R. Buckingham. For difficult reading material two comparable paragraphs were selected from Forms A and B of the Nelson-Denny Reading Test for Colleges and Senior High Schools. The comprehension questions on these paragraphs were administered immediately following the reading of the paragraph. The number of words in the four selections used for the eye-movement tests were 242, 161, 189, and 178, making a total sample of 770 words. The four selections are reproduced in Plates I-III. Although the subjects were so selected as to avoid any extreme visual deficiencies, the tests in the Keystone telebinocular series were administered to the remedial groups.

The materials used for vocabulary training were constructed specifically for the purpose of this experiment.<sup>2</sup> The purpose of this part of the study was to make a generalized attack on word meanings rather than to increase extent of vocabulary. The subjects studied the material and then prepared written exercises as evidence of their

<sup>2</sup> The vocabulary exercises were prepared by Miss Helen Kennedy, who served as research assistant for the study.



ability to apply what was learned. A more complete description appears in chapter iv.

Miscellaneous reading materials were used for practice throughout the experiment. Some subjects who were more rapid readers completed the film and vocabulary exercises in less time than the slower subjects and thereby gained some "free reading time." The materials used in this free reading time consisted in part of articles dealing with the improvement of reading and in part of general biographical and historical matter. During this part of the period the subjects were continually urged to read with great concentration and with the same feeling of regular progress which they experienced in using the film projector. A small amount of rhythmical poetry was employed during the first week of the remedial period to facilitate the transfer of rhythmical habits of reading from the film projector to reading directly from the printed page. The method of promoting this transfer will be described later.

*Apparatus used.*—Several forms of apparatus were used, although the more complicated of these would not be essential for carrying on a similar remedial program with students. For example, an eye-movement camera was employed to measure with precision the changes in perceptual habits which occurred during the experiment. In a scientific study accurate measurement is essential to determine the value of the procedures used. Once the worth of such procedures is determined, it is no longer necessary to make eye-movement photographs to check the progress of other remedial groups. There are simpler methods of measurement which are entirely satisfactory in an ordinary remedial program. An eye-movement camera should be considered a research rather than a clinical instrument.

The film projector used for controlling practice in reading was designed in the Laboratories for Educational Psychology at the University of Chicago. Five of these pieces of apparatus were built in the workshop of the laboratory for use in this experiment. The construction of this apparatus involved a long period of experimentation.

In the beginning of the experiment (1935) an ordinary sixteen-millimeter motion-picture projector was used to show dimly in the background the full page of material to be read, with parts of a line



Without hearing anything approach I suddenly became aware of a sound as if some one were softly bending a bush aside. Then came the soft stamp of a hoof. A deer was feeding within thirty yards of me. I could clearly hear her pull down the leaves and twigs of the sparkle-berry bush which she was munching. The faint night air was from me to her and she must have winded me, for she stood silent a moment, then gave a snort and a tremendous bound. I could hear her crashing through the brushwood for some distance.

In all parts of the country where they are hunted, deer are creatures of the night. Their day's program seems to be something like this. Retiring to their beds about sunrise, they spend the entire day drowsing and chewing the cud. When undisturbed in a good neighborhood for food, a deer will frequently return to the same bed for a week or longer. As the shadows tell that the day is near an end, the hungry deer rouse themselves, stretch like sleepy-headed boys, and begin to feed. They eat almost anything, but they will travel miles for certain foods, such as mushrooms, green wheat, apples, and peaches, and the tops of almost all vegetables. They wander, feeding, during the entire night, retiring into their resting-places at dawn. Where they lie depends a great deal on the weather; for the deer, while it does not especially mind the cold, dislikes wind, and it loves summer shade and winter sun.

In the same class belongs that pest the weasel, which is one of the few wild creatures that kill for the pleasure of killing. It is a fierce little beast that will kill things ten times its size. Many a poultry man has gone to his chicken house in the morning to discover twenty or more fine fowls with their throats cut. The weasel is a bloodsucker; and because it can creep through cracks no larger than rat holes, it is always a menace to the sleeping farm. Usually the weasel has its den in some old rock or log pile. I have found that it is fond of holes under banks in gullies, and I once discovered a family of seven in such a place. The mouth of their den, partly hidden by a heap of old trash, was strewn with the tattered remains of what had been a whole flock of fine chickens. The weasel, like the wild cat, deserves no mercy, though it is the foe of rats and mice.

PLATE II.—Easy material used for eye-movement records—Selection B

#### SELECTION A

The night was cloudy, and a drizzling rain, which fell without intermission, added to the obscurity. Steadily, and as noiselessly as possible, the Spaniards held their way along the main street, which had so lately resounded to the tumult of battle. All was now hushed in silence; they were only reminded of the past by the occasional presence of some solitary corpse, or a dark heap of the slain, which too plainly told where the strife had been hottest. As they passed along the lanes and alleys which opened into the great street, they easily fancied they discerned the shadowy forms of their foe lurking in ambush, ready to spring upon them. But it was only fancy; the city slept undisturbed even by the prolonged echoes of the tramp of the horses, and the hoarse rumbling of the artillery and baggage trains. At length, a lighter space beyond the dusky line of buildings showed the van of the army that it was emerging on the open causeway. They might well have congratulated themselves on having thus escaped the dangers of an assault in the city itself, and that a brief time would place them in comparative safety on the opposite shore.

#### SELECTION B

It now became evident that the city must be abandoned at once. There was some difference of opinion in respect to the hour of departure. The daytime, it was argued by some, would be preferable, since it would enable them to see the nature and extent of their danger, and to provide against it. Darkness would be much more likely to embarrass their own movements than those of the enemy, who were familiar with the ground. A thousand impediments would occur in the night, which might prevent their acting in concert, or obeying the orders of the commander. But, on the other hand, it was urged that the night presented many obvious advantages in dealing with a foe who rarely carried his hostilities beyond the day. The late active operations of the Spaniards had thrown the Mexicans off their guard, and it was improbable they would anticipate so speedy a departure of their enemies. With celerity and caution, they might succeed, therefore, in making their escape from the town, possibly over the causeway, before their retreat should be discovered; and, could they once get beyond that pass of peril, they felt but little apprehension for the rest of the journey.

PLATE III.—Difficult material used for eye-movement records—Selections A and B.

illuminated successively and brightly enough for reading. Later the dim background was eliminated, and only the parts of the line to be read were exposed. Two major difficulties were encountered with this model of the projector: First, there was a considerable glare due to the bright illumination necessary to make the sections of the lines clear enough to see. Second, the expense was too great since, with film running from sixteen to twenty frames a second, too large an

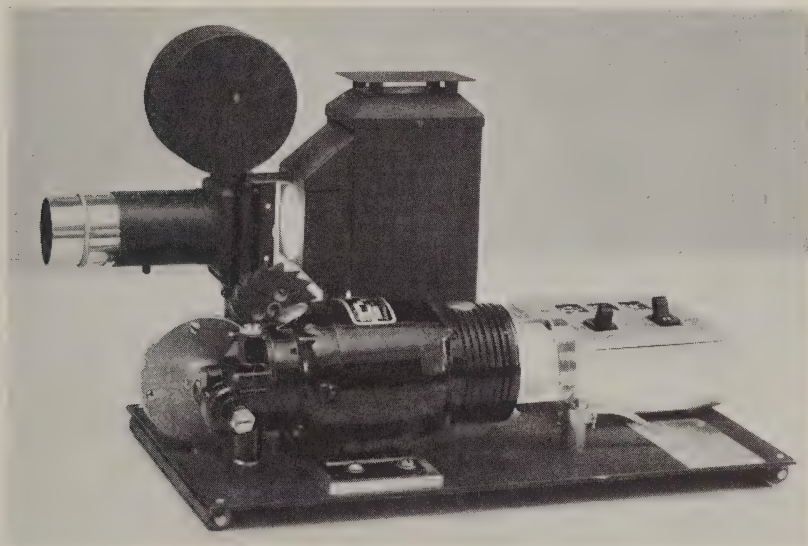


PLATE IV.—Film projector used in reading experiment

amount of film was necessary to expose each part of the line of print. Furthermore, it was extremely difficult to vary the speed of the projector within anything like a range necessary for subjects of different degrees of ability. Finally, in an attempt to work out a more satisfactory and less expensive apparatus, the entire principle of motion-picture projection was abandoned, and a new concept was developed.

In the new procedure the material was projected in parts of lines but by means of a "still-film projector" using thirty-five millimeter rather than sixteen-millimeter film. A special camera was built so that each exposure of printed material required only the space of



one perforation on the film. By this method one foot of motion-picture film is sufficient to photograph twenty lines of print with three exposures per line. By the earlier method, described above, to pro-

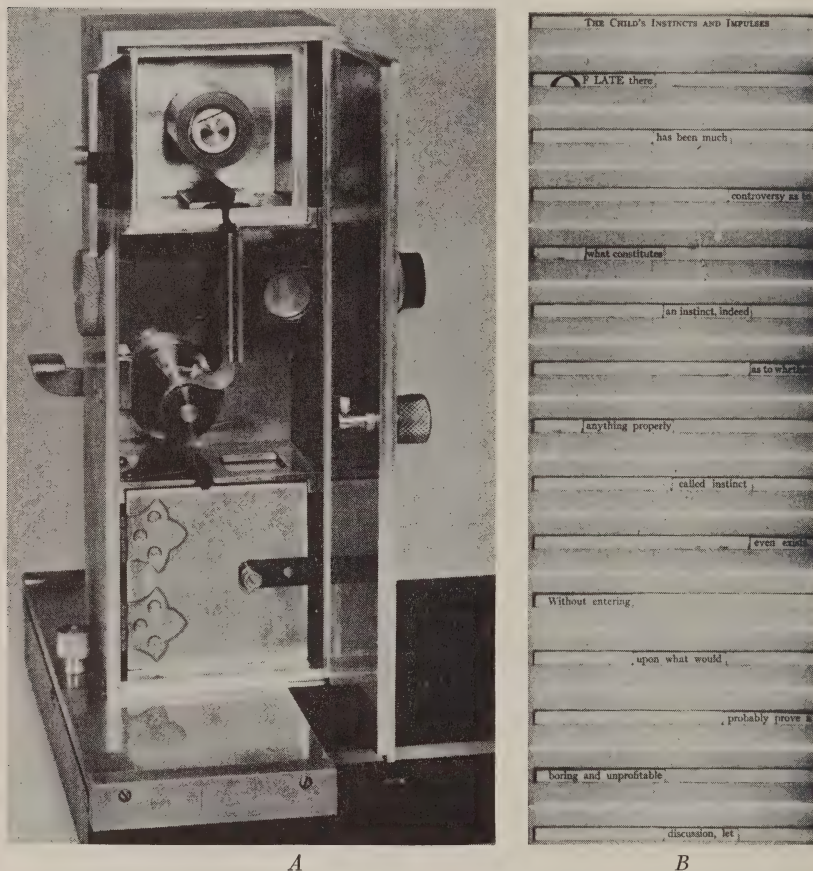


PLATE V.—(A) Camera used to photograph reading material for use in film projector. (B) Sample of film used in reading projector.

vide the same amount of reading material approximately twenty-five feet of film was needed. The enormous saving in film by this method is at once apparent. An ordinary ten-page selection of approximately three thousand words can be photographed on a fifteen-foot strip of film which, at three hundred words per minute, will provide ten



minutes of reading practice. Standard motion-picture film negative on a noninflammable base can be purchased for four cents a foot, and positive film, on which reprints may be made from a negative, can be purchased even more cheaply. It is readily seen, then, that the high operating cost of mechanical or motion-picture projectors now sold for this purpose may be drastically reduced. Furthermore, the projection apparatus needed for use with these still films can be manu-

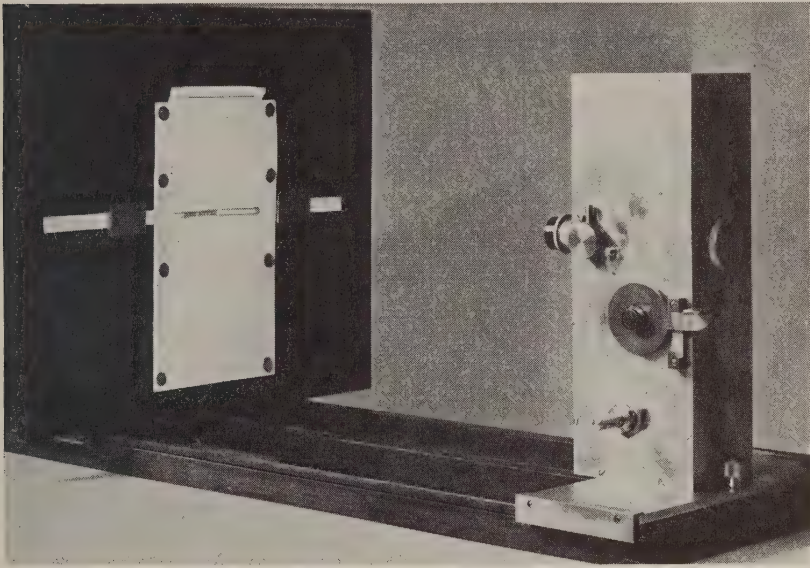


PLATE VI.—Apparatus for photographing reading material for film projector

factured for a fraction of the cost of certain pieces of mechanical apparatus now on the market or of the cost of equally substantial motion-picture-projection equipment. An even more important advantage of the still-film projector as compared with motion-picture projectors is its extreme flexibility in speed. The film may be shown at any rate from 150 to 900 words per minute.

The films used in this experiment were made with inexpensive camera equipment built in the laboratory's workshop. All the photographing was done by a student assistant. Samples of the reading materials used were checked against Thorndike's *The Teacher's Word*

*Book*.<sup>3</sup> Table 2 shows, for each sample, the percentage of words which falls in the first two thousand of the Thorndike list. The table

TABLE 2  
READING MATERIALS USED WITH THE FILM PROJECTOR

TITLE	AUTHOR OR EDITOR	VOCABULARY DIFFICULTY		TOTAL NUMBER OF PAGES PHOTO- GRAPHED FOR FILM PROJECTOR
		Number of Words Counted	Percentage of Words in Thorn- dike's First 2,000	
Selections from "Children's Bookshelf," Grade V.....	B. R. Buckingham	18,121	91	72
Selections from "Children's Bookshelf," Grade VI.....	B. R. Buckingham	32,086	91	124
Rules of the Road.....	American Council on Education	6,792	89	29
Story of Weights and Measures.....	American Council on Education	8,207	90	29
Story of Our Calendar.....	American Council on Education	7,437	90	29
Selections from "Reading to Learn," Book II.....	Yoakam, Bagley, and Knowlton	9,758	88	69
Selection from "Reading to Learn," Book III.....	Yoakam, Bagley, and Knowlton	3,073	86	22
Silver Chief to the Rescue...	Jack O'Brien	8,261	89	235
Burton Holmes Travel Stories—Japan.....	Burton Holmes	8,473	89	404
Selections from "The Child: His Nature and His Needs"	Contribution of the Children's Foundation, M. V. O'Shea (Editor)	11,911	84	90
Children's Village at Weggischeide.....	Esther Crane	3,514	88	9
The Exile.....	Pearl Buck	886	90	306
Total material available on film.....				1,418

also shows the number of pages of material that were photographed and used in the experiment. Sufficient material was used to provide

<sup>3</sup> Edward L. Thorndike, *The Teacher's Word Book*. New York: Teachers College, Columbia University, 1921.

a large amount of reading experience as a basis for improving the five factors on which the study was focused. Quantity was considered important in view of the hypothesis of the study, namely, that improvement should not be attempted by isolated exercises but should be obtained by supplying reading experience under controlled conditions sufficient to integrate these factors into a superior pattern of reading.

The illustrations of the film projector, the camera used in preparing film, and a sample of projection film are shown in Plates IV-VI. Other simple apparatus was used in the experiment, such as stop watches and metronomes.

*Individual procedure.*—Typical procedure for a subject in the main series of remedial experiments was as follows: Each subject was one of a small group which came to the laboratory for an academic hour (fifty minutes) five days a week for four weeks. On the first day the nature of the experiment was explained, and some of the tests were administered. The remaining tests were completed during the next two days. Also during the first three days of the experiment some practice with the film projector was given to each subject to acquaint him with it and to overcome any feeling of disturbance which apparatus might produce. In the same way each person was placed before the eye-movement camera and was asked to read two long paragraphs with the camera motors running but without film. Here again the purpose was to accustom the subject to the camera so that any changes occurring between the beginning and the end of the experiment would be valid changes in reading ability rather than changes brought about by extraneous adjustment to the apparatus. On the fourth day the initial eye-movement records, on the basis of which gains or losses were computed, were photographed. Also on the fourth day the reading projector was set at a rate corresponding to each subject's normal rate of reading directly from the printed page. On successive days the rate on projected material was stepped up approximately 5 per cent per day, provided the subject could accommodate himself to that speed. For some subjects the rate of increase was somewhat greater than 5 per cent per day for the first week. From the fourth day of the experiment on to the testing period at the end of the month, the subjects followed a program as follows:

twenty-five minutes of individual reading with the film projector, ten to fifteen minutes of work on vocabulary exercises, and ten to fifteen minutes in free reading or special instruction.

For a few minutes of the free reading time, during the first ten days of the experiment, the subjects read selections of rhythmical poetry with the beat of the metronome guiding their rate. The poetry was read silently, and the subjects were directed to keep the rhythm of their reading with the beat of the metronome, the speed being set at whatever speed was normal for them. These exercises with poetry were continued until a subject found no difficulty in reading with the metronome even when the rate was increased and he was pushed to keep up. At this point it was explained that the metronome could control the rate of reading printed prose material just as the film projector controlled the rate of reading of prose presented with the projector.

The metronome was presented to the subjects as a device to secure a fair degree of regularity in reading, and especially a feeling of continuously pushing on rather than loitering during the process of reading. In the opinion of the writer, the main contribution of any form of projection device is merely this motivating element of reading under pressure at a fairly constant speed. As will be described later, the subjects in Group IV substituted the metronome entirely for the film projector. As soon as the subjects in Groups I-III seemed to get the idea of regularity in reading prose, the use of poetry was completely dropped, but for Group IV the metronome was continued with prose for twenty-five minutes a day throughout the experiment.

There was no insistence that subjects make three eye fixations per line, since, as a matter of fact, no reader does that until he has had a long period of practice and has attained a high rate of reading. It is only fiction that children reading parts of lines exposed by apparatus make one fixation per exposure. The writer has checked repeatedly the number of fixations by using the eye-movement camera to photograph eye-movements while subjects read with the film projector. Ultimately, very rapid readers may make only three fixations per line of print, but extremely few are able to achieve this rate.



The last two days of the month's time was used for testing and for making final eye-movement records.

While the writer's scientific interests were centered on changes produced in such measurable items as span of recognition, reduction of regressive movements, reduction of duration of fixations, and the increase of rate to a point where vocalization would be impossible, the experiment was not discussed with the subjects in these terms. Although some of the eye-movement films were shown to the subjects, the records were described as symptoms of what was occurring rather than as causes for it. Reading was not evaluated in eye-movement terminology. The experiment was presented to the subjects in terms of the main purposes of reading, that is, reading with understanding and at a reasonably rapid rate.

Vocalization was explained as a carry-over from an oral-reading process where attention to each word is necessary. In contrast, it was emphasized that in silent reading attention should be focused on ideas rather than words and that meaning does not consist in a summation of individual words but rather in a fusion of words into ideas. It was pointed out that, if reading becomes too slow, it is almost impossible to avoid attention to single words and that speed of reading can be improved by thinking meanings rather than saying words.

Regularity of procedure line after line was explained to the subjects, not in terms of eliminating regressive movements, but in terms of concentration which normally produces regular progress. Flexibility was discussed with them, and it was pointed out that the type of materials used in this experiment could be read and understood by proceeding fairly regularly line after line. A high degree of mental concentration on what is read was urged as one of the principal means of improving both rate and understanding. The subjects were urged to push their reading to the point where it was uncomfortably rapid but not so rapid that they would fail to get the meaning of what was read. "Effort" and "concentration" were the key words used.

The hypothesis of the experiment was that, if subjects, by means of special effort and concentration, were able to read with understanding under conditions which characterized the reading habits of superior readers, they would gradually take on these methods of



reading, first during practice, then habitually. The only virtue of the film projector is that it aids in the process of pushing on to superior reading habits. By means of the projector, rate can be completely controlled. Words presented in groups rather than singly help develop a wider span of recognition. Furthermore, when material is presented in such a way that it disappears as soon as it is recognized and is followed at once by the next group of words, any possibility of regressive movements is eliminated, since, if the subject reads at all, he does it by a forward-moving process which is regular in nature.

The apparatus used in the experiment should be considered only as a means for implementing a modern theory of reading, namely, that reading consists in a process of fusing words into thought units and that these successive thought units should constitute the focus of attention.

## CHAPTER III

### PRELIMINARY EXPERIMENTS

THE techniques of the experiment were developed through the use of four preliminary groups, each group coming for a period of one month during the spring or summer of 1938. No summary statistical tabulations for these groups are presented because the procedures were changed so frequently that it is impossible to ascribe the results to any single variable.

The first group (Group A in Table 1) was made up of seven subjects, one of whom dropped out at the end of two weeks because of finding a full-time position. The procedure with this group of subjects consisted of practice in reading with the film projector and the reading of selections from different practice-books for remedial work. The film materials available at the time were limited and for the most part were taken from a sixth-grade reader and three pamphlets from the series "Achievements of Civilization," distributed by the American Council on Education. Because no more film was then available, the practice periods for Group A occupied approximately fifteen minutes a day. The Iowa Every-Pupil Test of Basic Skills, Test A, Silent Reading Comprehension, for 1937 and for 1938 were used at the beginning and the end of the experiment. Likewise, eye-movement records were taken at the beginning and the end of the month, but the selections were not standardized. Each subject was given visual tests with the Keystone telebinocular series.

The principal results gained from Group A were a better understanding of how much can be accomplished in a single hour and some improvement in the exercises used. The tests were not sufficiently standardized to permit high confidence in the results, although five of the six cases showed some improvement and one case very marked gains.

Group B was made up of eight subjects, somewhat varied in character. One of them was an airplane pilot with limited education but with an exceptional ambition to improve his reading because voca-

tional advancement seemed to him to depend on that. Another subject was a businessman who had found that his work was getting out of hand because of his inability to read rapidly. Another member of the group was a clubwoman who found herself embarrassed because she could not keep up in reading books which were familiar to most of the others in her club. Four of the group were students, and the remaining member was a student's wife who wished to improve her reading ability.

The procedure for Group B was substantially the same as for Group A with the following exceptions. A greater quantity of film had been prepared for the projector, so that Group B had more diversity in this kind of practice than did Group A. New selections were used for measuring changes indicated by the eye-movement film, the principal difference being that the selections for Group B were longer than those for Group A. The Iowa Silent Reading Test was administered at the beginning and the end of the remedial period.

As measured by the Iowa Silent Reading Test, the group made little change in comprehension, the scores at the end of the month being one per cent higher than at the beginning. In all other factors improvement occurred. All subjects gained in span of recognition by amounts ranging from 7 per cent to 64 per cent and in reduction of regressive movements from 27 to 71 per cent. Speed of perception showed an improvement in all cases except one, where the first and last scores were identical.

Group C consisted of seven subjects the treatment of whom varied from that of the earlier two groups chiefly in the increased use of the film projector and in the use of part of the reading time for the exercises in *Study Type of Reading Exercises* by Ruth Strang.<sup>1</sup> These exercises consisted of one-thousand-word selections followed by objective tests to measure comprehension. The content of the selections dealt with ways for improving reading. The Iowa Silent Reading Test was administered to this group also, but the selections used for the eye-movement records were different from those used with

<sup>1</sup> Ruth Strang and Others, *Study Type of Reading Exercises*. New York: Teachers College, Columbia University, 1935.

Group A or B. The gains made by this group were substantially the same as those exhibited by Group B.

Group D, made up of seven subjects, had the advantage of still more film to use with the projector. Two of the subjects dropped out during the experiment, only five records being left for final comparison. The average performance of these five showed an increase in rate of reading of 50 per cent, a gain in span of recognition of 44 per cent, a reduction of regressive movements amounting to 164 per cent, and an increase in speed of fixation pauses of 5 per cent. These averages are based on the reading of two parts of the same selection, the samples thus being of approximately equal difficulty.

By the time this fourth group of subjects had finished, certain facts stood out rather clearly. The Iowa Silent Reading Test was not a satisfactory measure for the objectives of the experiment. It is lithoprinted with long lines, and the tests available (for 1937 and 1938) were not sufficiently similar in difficulty and in number of questions for testing both rate and comprehension. The paragraphs used for eye-movement tests were changed to the final selections, which were longer and included comparable samples at two levels of difficulty. In addition, the records indicated difficulties resulting from vocabulary deficiency, and it seemed that special attention to this element was necessary. Consequently there was prepared a special body of vocabulary material which will be described in a later chapter. The general procedure in the laboratory was thought to be satisfactory as was the total amount of time and the length of the periods. Several mechanical changes were made in the film projector to make it a more efficient piece of apparatus. Improvements in methods of photographing and developing the projection films gave much clearer films for the latter part of the study.



## CHAPTER IV

### RESULTS OF REMEDIAL PROGRAM WITH FINAL EXPERIMENTAL GROUPS

IN THE presentation of the results of the experiment the data for Groups I, II, and III will be combined, since the treatment of these three groups was the same. The data for Group IV are presented separately because here the film projector was not used, this group having read directly from the printed page to the beat of a metronome for the same amount of time that Groups I, II, and III read from films. There were sixty-five subjects in Groups I, II, and III, and thirteen subjects in Group IV. Because of absence on testing days data on four subjects are missing from Table 3, which shows the results from the Pressey test of rate and comprehension, and from Table 4, which gives the data from the eye-movement records. Also in Table 4 the records are missing for one subject in Section A and three subjects in Section B because they moved their heads while the eye-movement films were being made.

The data in Tables 3 and 4 are expressed in percentages of gain or loss in the final tests as compared with the initial tests at the beginning of the experiment. Medians rather than means are used to summarize the tables because the extremely high gains of a few individuals distorted the means unduly. Variations from the medians are indicated by the quartile deviation.

The general results of the experiment for Groups I, II, and III combined and for Group IV separately will be presented first. The subjects will then be reclassified according to rate of reading at the beginning of the experiment and the data will be analyzed in terms of rapid, average, and slow readers. Certain individual cases will be analyzed to give a more concrete picture of the working of the remedial program.

#### GENERAL RESULTS OF REMEDIAL PROGRAM

Table 3 shows the scores for each subject and the combined scores for Groups I-III and for Group IV on the Pressey reading test. The

TABLE 3

EFFECT OF REMEDIAL PROGRAM AS MEASURED BY PRESSEY'S TEST OF READING  
SPEED AND COMPREHENSION (SUBJECTS ARRANGED ACCORDING  
TO INITIAL RATE ON PRESSEY TEST)

SUBJECT NUMBER	NUMBER OF WORDS READ PER MINUTE			COMPREHENSION SCORE		
	Initial	Final	Percentage of Gain	Initial	Final	Percentage of Gain
Groups I, II, III:						
71.....	790	826	5	100	90	-10
33.....	678	546	-19	90	75	-17
69.....	552	627	14	100	90	-10
93.....	533	551	3	80	80	0
34.....	484	467	-4	90	90	0
55.....	473	376	-21	60	75	25
62.....	469	437	-7	90	95	6
85.....	436	509	17	100	95	-5
86.....	430	677	57	90	85	-6
72.....	430	429	0	80	80	0
64.....	424	431	2	90	95	6
79.....	419	455	9	100	80	-20
60.....	419	346	6	90	100	11
44.....	378	398	5	100	85	-15
50.....	367	449	22	80	80	0
76.....	365	401	10	80	85	6
67.....	361	423	17	90	80	-11
89.....	351	413	18	60	90	50
51.....	351	326	-7	100	90	-10
57.....	346	291	-16	80	100	25
61.....	337	494	47	100	85	-15
39.....	335	440	31	90	75	-17
84.....	335	651	94	90	95	6
73.....	335	411	23	100	90	-10
68.....	334	484	45	100	75	-25
65.....	332	449	35	100	90	-10
41.....	320	276	-14	100	95	-5
91.....	318	406	28	100	90	-10
66.....	318	418	31	90	80	-11
49.....	317	312	-2	90	75	-17
59.....	312	244	-22	100	95	-5
48.....	312	289	-7	100	100	0
45.....	312	366	17	100	85	-15
42.....	306	484	58	90	90	0
32.....	306	392	28	70	50	-29
52.....	292	376	29	100	100	0
77.....	288	477	66	90	95	6
31.....	280	317	13	100	100	0
54.....	279	449	61	100	80	-20
78.....	276	398	44	100	95	-5
74.....	275	446	62	80	80	0
87.....	270	358	33	90	90	0
80.....	267	355	33	90	90	0

TABLE 3—*Continued*

SUBJECT NUMBER	NUMBER OF WORDS READ PER MINUTE			COMPREHENSION SCORE		
	Initial	Final	Percentage of Gain	Initial	Final	Percentage of Gain
Groups I, II, III— <i>continued:</i>						
82.....	266	358	35	80	95	19
37.....	262	307	17	100	75	-25
94.....	260	347	33	100	100	0
83.....	260	234	-10	60	100	67
70.....	260	261	0	80	95	19
35.....	255	329	29	90	85	-6
81.....	249	247	-1	90	95	6
36.....	244	260	10	70	80	14
92.....	233	266	14	90	85	-6
88.....	228	301	32	90	90	0
30.....	204	339	66	60	80	33
46.....	203	300	48	100	75	-25
47.....	194	223	15	90	90	0
53.....	193	273	41	90	85	-6
58.....	189	239	26	60	70	17
40.....	174	249	43	90	95	6
90.....	160	182	14	90	90	0
75.....	141	188	33	40	80	100
Median.....	312	392	17*	90	90	0*
Quartile deviation.....	53	77	16	10	8	8
Group IV:						
134.....	405	335	-17	100	90	-10
126.....	390	398	2	80	100	25
133.....	390	403	3	100	85	-15
123.....	390	639	64	80	90	13
131.....	385	394	2	100	90	-10
130.....	378	368	-3	100	100	0
122.....	359	421	17	100	85	-15
129.....	282	288	2	80	85	6
127.....	263	274	4	80	95	19
132.....	250	249	0	70	85	21
128.....	247	270	9	70	95	36
125.....	241	372	54	90	100	11
124.....	239	337	41	80	70	-13
Median.....	359	368	3*	80	90	6*
Quartile deviation.....	71	60	14	10	7	16

\* The figures marked with asterisks represent the median percentages of gain, not the percentages calculated from the median scores.

TABLE 4

EFFECT OF REMEDIAL PROGRAM ON (1) SPAN OF RECOGNITION, (2) REDUCTION OF REGRESSIVE MOVEMENTS, (3) SPEED OF RECOGNITION, AND (4) RATE OF READING AS MEASURED BY EYE-MOVEMENT RECORDS (SUBJECTS ARRANGED ACCORDING TO RATE ON PRESSEY TEST)

SUBJECT NUMBER	AVERAGE NUMBER OF WORDS READ PER FIXATION			AVERAGE NUMBER OF WORDS READ PER REGRESSION			AVERAGE NUMBER OF FIXATIONS PER SECOND			AVERAGE NUMBER OF WORDS READ PER MINUTE			
	Initial	Final	Per- centage of Gain	Initial	Final†	Percent- age of Gain	Initial	Final	Per- centage of Gain	Initial	Final	Per- centage of Gain	
Section A. Easy Reading Material													
Groups I, II, III:													
71.....	2.2	2.6	18	30.3	53.7	77	5.0	4.9	- 2	663	767	16	
33.....	2.3	2.5	9	30.3	70.5	133	4.4	4.6	5	602	677	12	
69.....	2.4	3.0	25	30.3	130.0+	329	3.7	3.8	3	532	690	30	
93.....	1.8	2.0	11	20.2	32.2	59	4.5	4.7	4	481	505	17	
34.....	2.8	3.4	21	77.0	141.0+	83	4.6	4.7	2	766	972	27	
55.....	1.5	1.7	13	22.0	70.5	220	4.5	4.9	9	408	495	21	
62.....	2.0	1.8	-10	34.6	17.6	49	4.2	4.4	5	509	481	- 6	
81.....	1.9	2.3	21	48.4	161.0	233	4.3	4.1	- 5	496	562	13	
86.....	1.5	2.4	60	7.1	32.2	354	4.8	4.9	2	430	716	67	
72.....	1.8	2.3	28	15.1	20.1	33	5.2	5.3	2	556	721	30	
64.....	1.7	2.1	24	24.2	35.3	46	4.5	5.2	16	467	671	44	
79.....	1.7	2.1	24	40.3	161.0	300	4.6	4.8	4	468	660	28	
60.....	1.4	2.2	57	8.1	20.1	148	4.8	5.2	8	415	682	64	
44.....	1.6	1.8	13	5.3	5.9	11	5.3	5.4	2	491	583	19	
50.....	1.3	2.0	54	8.3	17.6	112	4.9	5.4	10	391	636	63	
76.....	1.6	2.1	31	20.2	53.7	166	4.7	4.9	4	461	619	34	
67.....	1.6	2.0	25	20.2	47.0	133	4.4	4.9	11	410	583	42	
89.....	1.3	2.1	62	17.3	23.0	33	4.6	5.3	15	368	671	82	
51.....	1.5	1.5	0	13.4	10.1	-	25	3.7	4.4	19	321	397	24
57.....	1.2	1.5	25	4.4	6.4	45	4.2	3.7	-12	314	322	3	
61.....	1.5	2.2	47	12.7	35.3	178	4.4	4.8	9	392	641	64	
39.....	1.3	2.3	77	9.7	141.0	1,354	5.0	5.4	8	382	742	94	
84.....	1.4	2.5	79	11.5	80.5	600	3.6	3.4	- 6	318	508	60	
73.....	1.4	1.9	36	10.5	32.2	207	4.6	4.4	- 4	401	511	27	
68.....	1.6	2.5	56	17.3	141.0	715	4.4	5.5	25	431	821	90	
65.....	1.2	1.9	58	7.1	47.0	502	4.4	4.3	- 2	327	481	47	
41.....	1.6	1.9	10	20.2	28.2	40	4.6	4.5	- 2	448	507	13	
91.....	1.4	2.2	57	8.1	23.0	184	4.7	5.0	6	390	657	68	
66.....	1.3	1.4	8	5.0	5.6	12	4.1	4.5	10	314	374	19	
49.....	1.8	2.6	44	17.8	35.3	98	4.6	5.0	9	504	776	54	
59.....	1.4	1.4	0	24.2	28.2	17	4.3	4.4	2	355	376	6	
48.....	1.6	2.8	75	11.5	35.3	207	4.4	4.9	11	431	806	87	
45.....	1.6	2.0	25	40.3	35.3	-	12	3.7	4.4	19	359	522	45
42.....	1.7	2.5	47	22.0	22.4	12	3.8	4.7	24	383	723	89	
32.....	1.4	1.5	7	7.3	7.8	48	4.9	4.8	- 2	423	448	6	
52.....	1.2	1.3	8	7.6	7.8	3	4.7	4.6	- 2	352	365	4	
77.....	1.8	2.6	44	34.6	53.7	55	3.7	5.0	35	397	773	95	
31.....	1.5	1.6	7	16.1	11.8	27	3.7	3.7	0	327	360	10	
54.....	1.5	2.5	67	15.1	23.5	56	3.9	4.6	18	347	682	97	
78.....	1.4	2.0	43	8.1	17.9	121	3.7	4.2	14	309	517	67	
74.....	1.7	2.8	65	18.6	53.7	189	3.9	4.2	8	391	695	78	
87.....	1.4	2.2	57	20.2	80.5	299	3.9	4.4	13	323	593	84	
80.....	1.0	1.6	60	4.2	14.6	248	4.2	4.2	0	249	406	63	
82.....	1.1	1.6	45	8.3	26.8	223	4.3	4.0	14	291	480	65	
37.....	1.4	2.1	55	13.1	35.3	169	4.1	4.1	0	349	516	48	
94.....	1.4	1.5	7	8.6	10.7	24	4.5	5.0	11	360	456	24	
83.....	1.2	1.6	33	5.9	14.6	147	3.9	3.9	0	274	385	41	
70.....	1.3	1.7	31	6.5	8.0	37	4.6	4.7	2	346	483	40	
35.....	1.9	2.3	21	40.3	28.2	-	30	4.1	4.4	7	473	604	28
81.....	1.1	1.4	27	7.6	10.1	33	4.4	4.8	9	296	391	32	

\* The figures marked with asterisks represent the median percentages of gain, not the percentages calculated from the median scores.

† The records followed by plus signs in this column are records of subjects who made no regressions in the total amount read in the final test. The plus signs indicate that these records might have been higher if the selection had been longer.



TABLE 4—Continued

SUBJECT NUMBER	AVERAGE NUMBER OF WORDS READ PER FIXATION			AVERAGE NUMBER OF WORDS READ PER REGRESSION			AVERAGE NUMBER OF FIXATIONS PER SECOND			AVERAGE NUMBER OF WORDS READ PER MINUTE		
	Initial	Final	Per- centage of Gain	Initial	Final†	Percent- age of Gain	Initial	Final	Per- centage of Gain	Initial	Final	Per- centage of Gain
Section A. Easy Reading Material—Continued												
Groups I, II, III —continued:												
36.....	1.7	1.7	0	26.9	141.0	424	4.8	4.8	0	484	495	2
92.....	1.2	1.4	17	5.4	8.1	50	3.2	4.2	31	230	353	53
88.....	1.3	1.8	38	7.3	53.7	636	4.5	5.2	16	348	552	59
30.....	1.1	1.6	45	5.8	6.7	16	4.1	4.1	0	270	405	50
46.....	1.0	1.5	50	5.1	12.8	151	3.8	3.9	3	234	347	48
47.....	1.1	1.2	9	5.3	5.9	11	4.0	4.3	8	250	298	15
53.....	0.9	1.0	11	3.2	3.7	16	3.8	4.0	20	195	234	20
58.....	1.1	1.3	18	6.5	6.7	3	3.8	3.8	0	244	291	10
40.....	1.4	1.5	7	20.2	20.1	0	3.3	3.6	9	270	320	18
90.....	0.8	1.0	25	3.3	4.4	33	3.7	3.5	5	167	208	25
75.....	1.0	1.3	30	6.9	8.5	23	3.4	3.5	3	205	265	29
Median.....	1.4	2.0	30*	12.7	26.8	77*	4.4	4.6	5*	382	517	34*
Quartile de- viation...	0.2	0.4	17	7.0	21.5	91	0.4	0.4	6	71	140	22
Group IV:												
134.....	1.4	1.6	14	10.5	12.4	18	4.8	4.9	2	403	456	13
126.....	1.8	2.5	39	11.0	12.4	13	3.4	3.8	12	366	552	51
133.....	2.0	2.8	40	11.5	23.0	100	4.2	4.2	0	504	710	41
123.....	2.2	2.3	5	48.4	83.0	71	4.2	4.5	7	565	623	10
131.....	1.6	2.7	69	9.1	54.0	493	4.5	4.2	— 7	420	675	61
130.....	1.9	2.4	26	34.6	53.7	55	3.9	3.5	— 10	454	501	10
122.....	2.0	2.2	10	21.0	13.4	— 36	3.6	4.2	17	420	558	30
129.....	1.4	1.9	36	9.3	16.1	73	4.2	4.4	5	365	511	40
127.....	1.2	1.5	25	9.7	23.0	137	4.2	4.2	0	304	376	24
132.....												
128.....	1.5	1.7	13	15.1	14.6	— 3	4.2	4.3	2	379	431	14
125.....	2.1	2.3	10	60.5	161.0+	166	4.2	4.1	— 2	524	575	10
124.....	1.5	2.7	80	30.3	161.0+	431	3.6	3.9	8	318	623	96
Median.....	1.7	2.3	26*	13.3	23.0	72*	4.2	4.2	2*	412	555	27*
Quartile de- viation...	0.3	0.4	14	11.2	27.3	68	0.2	0.2	5	57	70	17
Section B. Difficult Reading Material												
Groups I, II, III:												
71.....	2.2	2.3	5	21.0	44.5	112	5.1	4.5	— 12	667	621	— 7
33.....	2.1	2.3	10	17.2	25.4	48	4.0	4.5	13	495	610	23
69.....	2.1	2.7	29	17.2	35.6	107	3.4	3.0	15	431	632	47
93.....	1.9	2.1	11	23.6	25.4	8	4.5	4.9	9	511	610	19
34.....	2.1	2.5	19	27.0	19.8	— 27	4.3	4.5	5	540	676	25
55.....	1.4	1.8	29	11.8	29.7	152	4.4	4.7	7	377	497	32
62.....	1.4	2.1	50	8.6	33.3	287	4.3	4.3	0	397	543	48
85.....	1.4	1.9	36	9.0	44.5	349	3.9	3.7	— 5	322	434	35
86.....	1.7	2.1	24	9.0	14.8	64	4.8	4.7	— 2	489	580	19
72.....	1.4	1.7	21	7.9	14.8	87	4.8	4.7	— 2	412	485	18
64.....	1.4	1.7	21	9.5	9.9	4	4.3	4.8	12	374	483	29
79.....	1.7	1.7	0	27.0	35.6	32	4.1	4.3	5	418	440	5
60.....	1.5	2.0	33	10.9	22.3	105	4.3	4.9	14	490	600	50
44.....	1.0	1.2	20	2.8	3.5	25	4.6	4.7	2	289	339	17
50.....	1.3	1.9	46	7.9	12.7	61	4.6	5.2	13	372	597	60
76.....	1.6	1.8	13	21.0	25.4	21	4.2	4.3	2	415	473	14
67.....	1.4	1.7	21	18.8	19.8	5	3.5	4.3	23	294	424	44

\*The figures marked with asterisks represent the median percentages of gain, not the percentages calculated from the median scores.

TABLE 4—Continued

SUBJECT NUMBER	AVERAGE NUMBER OF WORDS READ PER FIXATION			AVERAGE NUMBER OF WORDS READ PER REGRESSION			AVERAGE NUMBER OF FIXATIONS PER SECOND			AVERAGE NUMBER OF WORDS READ PER MINUTE		
	Initial	Final	Per- cent- age of Gain	Initial	Final†	Percent- age of Gain	Initial	Final	Per- cent- age of Gain	Initial	Final	Per- cent- age of Gain
Section B. Difficult Reading Material—Continued												
Groups I, II, III —continued:												
80.....	I. 2	I. 7	42	6.3	25.4	303	4.2	5.0	10	302	513	70
51.....	I. 4	I. 1	—21	7.9	3.9	51	3.7	4.0	8	297	271	—9
57.....	I. 0	I. 2	20	3.0	4.6	53	4.0	4.0	0	233	283	21
61.....	I. 6	2.3	44	13.5	80.0	559	3.0	4.5	15	306	632	73
39.....	I. 4	2.2	57	9.9	80.0	790	3.9	5.1	4	402	668	66
84.....	I. 4	2.3	64	8.6	25.4	105	3.0	3.5	17	245	490	100
73.....	I. 2	I. 7	42	5.7	16.2	184	4.3	4.5	5	303	341	52
68.....	I. 5	2.2	47	11.1	59.3	434	4.4	5.1	10	390	676	73
65.....	I. 3	I. 6	23	6.3	16.2	157	4.3	4.3	0	328	409	25
41.....	I. 5	I. 5	0	15.8	14.8	—6	4.2	4.3	2	382	394	3
91.....	I. 4	I. 8	20	7.9	19.8	151	4.4	4.8	9	366	504	38
66.....	I. 2	I. 3	8	3.5	4.9	40	3.9	4.4	13	273	341	25
40.....	I. 5	2.4	60	11.8	178.0	1,408	4.1	4.5	10	360	663	84
50.....	I. 4	I. 2	—14	13.7	13.7	0	3.6	3.7	3	295	264	—11
48.....	I. 3	2.3	77	7.5	14.8	97	3.7	4.1	11	282	562	99
45.....	I. 3	I. 7	31	14.5	44.5	207	3.3	4.1	24	266	422	59
42.....	I. 3	I. 6	23	6.8	13.7	101	3.4	4.2	24	267	397	49
32.....	I. 1	I. 4	27	4.2	8.1	93	4.2	4.6	10	266	396	49
52.....	I. 1	I. 2	9	5.1	5.4	6	4.1	4.6	12	267	326	22
77.....	I. 6	2.2	38	21.0	25.4	21	3.5	4.6	31	343	593	73
31.....	I. 3	I. 7	31	9.5	29.7	213	3.0	3.1	3	242	320	36
54.....	I. 2	2.1	75	8.2	16.2	98	3.6	4.4	22	267	505	112
78.....	I. 2	I. 7	42	5.9	14.8	151	3.1	3.6	16	224	381	70
74.....	I. 5	2.5	67	14.5	59.3	300	3.4	3.8	12	300	571	85
87.....	I. 4	I. 9	36	21.0	178.0	748	3.6	4.4	22	307	494	61
80.....	I. 0	I. 2	20	3.6	5.7	58	3.6	3.9	8	212	272	28
82.....	I. 2	I. 5	25	8.2	14.8	80	3.4	4.3	26	245	384	57
37.....	I. 5	2.0	33	11.1	107.0+	864	3.2	3.1	—3	281	360	31
94.....	I. 1	I. 4	27	4.7	11.1	136	4.3	4.4	2	287	384	34
83.....	I. 0	I. 1	10	4.5	6.8	51	3.4	3.4	0	209	231	11
70.....	I. 1	I. 4	27	3.8	6.4	68	4.2	4.3	2	270	370	37
35.....	I. 5	I. 8	20	7.3	13.7	88	4.1	4.3	5	371	453	22
81.....	I. 1	I. 2	9	5.1	5.7	12	4.4	4.5	2	285	310	9
36.....												
92.....	I. 2	I. 3	8	4.9	6.4	31	2.8	3.7	32	204	294	44
88.....	I. 1	I. 5	36	4.4	13.7	211	4.0	4.0	23	260	434	67
39.....	I. 1	I. 4	27	4.4	6.4	45	3.3	3.6	9	208	296	42
46.....	0.8	I. 1	38	2.7	5.2	93	3.4	3.7	9	159	239	50
47.....	0.0	0.8	—11	3.4	2.4	—29	3.5	3.0	11	181	174	—4
53.....	0.8	I. 0	25	3.0	5.4	—80	3.6	3.1	—14	165	195	18
58.....	I. 2	I. 2	0	10.5	6.6	—37	3.5	3.4	—3	260	239	—8
40.....	I. 2	I. 4	17	9.5	17.8	87	3.0	3.4	13	213	277	30
90.....	0.8	0.8	0	3.0	3.4	13	3.5	3.7	6	157	168	7
75.....	I. 1	I. 1	0	7.1	6.1	—14	2.4	3.2	33	164	212	29
Median.....	I. 3	I. 7	25*	8.2	14.8	87*	4.0	4.3	9*	295	429	35*
Quartile deviation...	0.2	0.4	13	3.9	10.6	74	0.4	0.4	7	60	123	20
Group IV:												
134.....	I. 5	I. 5	0	15.8	11.1	—30	4.9	4.7	—4	454	422	—7
126.....	I. 5	I. 3	—13	6.8	5.7	—16	3.3	3.7	12	295	287	—3
133.....	I. 8	2.7	50	8.6	22.3	159	4.3	4.0	—7	493	651	41
123.....												
131.....	I. 2	I. 8	50	5.6	14.0	166	4.4	4.4	0	310	471	52
130.....	I. 6	I. 0	19	11.1	11.8	6	3.8	3.6	—5	372	412	11
122.....												
129.....	I. 4	I. 8	29	11.9	15.8	33	3.8	4.0	5	327	433	32

TABLE 4—*Continued*

SUBJECT NUMBER	AVERAGE NUMBER OF WORDS READ PER FIXATION			AVERAGE NUMBER OF WORDS READ PER REGRESSION			AVERAGE NUMBER OF FIXATIONS PER SECOND			AVERAGE NUMBER OF WORDS READ PER MINUTE			
	Initial	Final	Per- centage of Gain	Initial	Final†	Percent- age of Gain	Initial	Final	Per- centage of Gain	Initial	Final	Per- centage of Gain	
Section B. Difficult Reading Material— <i>Continued</i>													
Group IV— <i>con- tinued:</i>													
I27.....	I.1	I.2	9	8.6	10.5	22	4.0	4.2	5	269	312	16	
I32.....	I.3	I.3	0	12.6	19.8	57	3.3	3.3	0	251	270	8	
I28.....	I.3	I.4	8	11.9	7.6	—	36	3.9	3.8	—	303	312	3
I25.....	2.1	2.0	—	37.8	59.3	57	4.4	4.0	—	9	567	479	—
I24.....	I.4	2.0	43	14.5	178.0+	1,128	3.5	3.0	—14	298	473	59	
Median.....	I.4	I.8	9*	11.9	14.9	33*	3.9	4.0	—3*	310	422	11*	
Quartile de- viation...	0.2	0.4	22	3.0	5.9	77	0.5	0.3	6	80	81	22	

initial scores in this table are based on the first half of the test, which was administered at the beginning of the remedial period. The final scores are from the second half of the test which was given at the end of the month of remedial work. For the 61 cases in Groups I—III combined the median rate of reading at the beginning of the experiment was 312 words per minute; at the end it was 392 words per minute, a median gain in rate of 17 per cent. For comprehension the median scores at the beginning and at the end were the same, namely, 90, a median change of zero. Forty-seven of the 61 cases made gains in rate, two made no change, while 12 lost in rate. In comprehension 18 of the 61 subjects gained, 15 remained the same, and 28 showed losses. As far as the Pressey test measured the result of the experiment, the median outcome was a gain of 17 per cent in rate of reading without either gain or loss in comprehension. The quartile scores show a considerable deviation in each of the measures, a fact which should be noted in interpreting the results. Evidently a group of cases larger than 61 would be necessary to stabilize the results of the experiment.

Group IV, which substituted a metronome for the film projector, showed a median gain of 3 per cent in rate and of 6 per cent in comprehension. Ten of the 13 subjects gained in rate, while seven of the 13 improved in comprehension. The group is too small for the re-

sults to be highly significant, but it is interesting to note that two of the subjects made large gains in both rate and comprehension by the use of the simplest and most inexpensive sort of apparatus.

The data in Table 4 are presented in two sections. Section A gives the results of the eye-movement records at the beginning and the end of the experiment on two comparable selections of easy material. Section B gives corresponding results for two selections of more difficult material, also taken at the beginning and the end of the experiment. These four sample selections are reproduced on pages 20-22.

Four indexes are used to interpret the results of the remedial program, as shown in Table 4. The first index is span of recognition, which is recorded as the average number of words read per fixation. The second index is regularity of procedure along the lines of print, as indicated by the average number of words read per regression. Under this column the plus signs given after the records for six cases (Subjects 69, 34, 125, and 124 in Section A, and Subjects 37 and 124 in Section B) indicate that no regressions occurred in the total amount read. Consequently each record shows the total number of words read with a plus sign to indicate that the number might have been still higher had the selection been longer. The third index in Table 4, speed of recognition, is given in terms of the average number of fixations per second rather than in terms of the duration of a single fixation because for most readers the former figure is more meaningful. The fourth index in Table 4 is rate of reading on the eye-movement paragraph, expressed by the average number of words read per minute. The subjects in Table 4 are listed in the same order as in Table 3.

Table 4 should be read as follows: Subject 71 had an average span of recognition of 2.2 words per fixation at the beginning of the experiment and of 2.6 words at the end of the month, a gain in span of recognition of 18 per cent. When first tested, he made an average of one regressive movement for each 30.3 words, whereas when last tested one regressive movement was made for every 53.7 words, a gain of 77 per cent in this factor. In speed of recognition this subject changed from an initial average of 5.0 fixations per second to 4.9 fixations in the final record, a loss of 2 per cent; while in rate of read-



ing he changed from 663 words per minute to 767 words, a gain of 16 per cent.

On the easy material in Section A the 61 subjects in Groups I-III combined made a median gain of 30 per cent in span of recognition, of 77 per cent in regularity of reading with fewer regressive movements, of 5 per cent in speed of recognition, and of 34 per cent in rate of reading. Fifty-seven of the 61 subjects improved in span of recognition; 55 of them made gains in reducing regressive movements; 44 made gains in speed of recognition; while 60 of the 61 increased their average rate of reading.

The quartile deviations for Groups I-III combined show small variations from the median in span of recognition. The reduction in regressive movements shows a wider deviation from the median, although it should be noted that, since regressions are few in number, the reduction of even one in regressive movements may make a considerable gain in number of words read per regression. However, the gains in this factor are clear cut, and the remedial treatment may unquestionably be said to have assisted the readers to proceed along the lines of print with regularity. Rate of recognition shows relatively small deviation from the median, although the total gain here is much smaller than in span of recognition or elimination of regressive movements. As was mentioned before, rate of recognition is exceedingly hard to modify, but 44 of the 61 subjects did make some improvement. The median gain in rate of reading was 34 per cent, which is twice the gain registered on the Pressey reading test.

The median gains for Group IV in Table 4, Section A, were likewise positive in all cases, amounting to 26 per cent in span of recognition, 72 per cent in regularity of procedure along the lines, 2 per cent in speed of recognition, and 27 per cent in rate of reading. It should be noted that the gains here are very substantial as compared with those for Groups I-III and that these gains were secured without the use of any apparatus other than a metronome.

The situation portrayed in Section B of Table 4 differs from that in Section A in two respects: First, the material read was more difficult. Second, the subjects were told, before they began to read, that at the end questions would be asked about the selections. Consequently there was a slowing-down in the rate of reading, together with a re-

duction in the span of recognition and in the number of words read per regression, and a retarding of the rate of recognition. All these adaptations are to be expected and are exactly in line with findings of previous research. The important point here, however, is the progress which occurred between the beginning and the end of the remedial period. As indicated in the table, for Groups I-III, the percentages of improvement are, with one exception, greater than those shown for the reading of easy material. In span of recognition there is a median gain of 25 per cent; in reduction of regressive movements, 87 per cent; in speed of recognition, 9 per cent; and in rate of reading, 35 per cent. Again the data show clearly that these factors were affected in both positive and substantial amounts by the remedial program.

In the reading of difficult material (Section B), Group IV, which did not use the film projector, made less improvement than the subjects in Groups I-III. Group IV also made less improvement on the difficult selections than on the easy ones. They made a median gain of 9 per cent in span of recognition, of 33 per cent in regularity of procedure, a loss of 3 per cent in speed of recognition, and a gain of 11 per cent in rate of reading.

As explained in an earlier chapter, this study was an attempt to find what gains could be made in five important factors integral to reading by means of a remedial program which treated them, not in isolated exercises, but rather by controlling the subject's reading in such a way that practice in these factors was integrated into the total reading situation. The data in Table 4 have shown that the methods employed produced a substantial median gain in as short a period as twenty hours of work spread over a month. Before further interpretation of these data is attempted, the results of the vocabulary exercises used in the remedial program will be presented.

The subjects in Groups I-IV were given vocabulary exercises in addition to practice with the film projector or the metronome. The exercises used were made after a rather extensive survey of the literature dealing with methods which have been used for reducing vocabulary difficulties in reading.

The first exercise was designed to assist the subjects in determining the meaning of an unknown word from its context. Four words

were selected, at least two of which were unfamiliar to the majority of the subjects. A list of the words was given to each subject, and he was asked to define them before looking at the paragraphs in which they were used and in which the context, it was believed, suggested their meanings. After attempting to define the words independently, the subject read the paragraphs and, on a separate sheet, wrote definitions for any of the words which he had not known originally or for which the definition was in error or incomplete. The subjects were given help with any exercise with which they had difficulty.

The second exercise was planned to derive meaning of the unknown from the known. The subjects were asked to list all the words they could think of containing the roots *tele* and *graph*. From a consideration of the meanings of the words in the two groups, it was expected that they would see the derivation of the definition of "telegraph."

In the next two assignments the subjects were asked to list all words they could think of built on the root *mittere* or *missus*, and with the prefixes *re-* and *ad-*. The addition of suffixes to a list of words made up the fifth exercise.

The sixth exercise necessitated several days of working time. The subjects were given a list of Latin and Greek roots and were then asked to give the meaning of a root, such as *audio* meaning "to hear," and a word derived from it, for example, "auditorium."

Exercises 7 and 8 had to do with changes in the spelling of a prefix to facilitate the pronunciation of the word. A list of words was given in which the subject was asked to underline the prefix and indicate by number, following a key, to which prefix group it belonged. The next assignment gave a list of suffixes, with the meaning and an example of each, which the subjects were to study. They were then asked to list the ten with which they were most familiar.

A series of roots were given in the tenth exercise and the subjects were asked to combine them into words; for example, *auto*, *bio*, *graph*, could be combined to make "autobiography." Prefixes and suffixes might be used with a combination of the roots. Then followed an exercise concerning the use of the dictionary. Among other things the subjects were asked to list the information that could be

obtained from a dictionary. Such lists named from two to twelve uses.

The remaining exercises were selections from different subject fields, the subject being asked to indicate unknown words.

In the initial testing program all subjects had been given Form A of the Nelson-Denny Reading Test for Colleges and Senior High Schools, which includes a vocabulary section of one hundred words. The vocabulary test was not administered with the ten-minute time limit indicated by the authors; instead the subjects were permitted to finish the test and their time was recorded. The median of the correct responses for the combined groups on the initial test was 76, with a standard deviation of 13.

The series of vocabulary exercises described above was given to all the subjects. Approximately fifteen minutes daily was devoted to this work for sixteen of the twenty days in the experimental period. Form B of the Nelson-Denny test was given at the end of the experiment. The median for the vocabulary section of the final test was 76, with a standard deviation of 13. The difference between the means of the two tests was therefore zero. The authors report a correlation of  $.914 \pm .013$  between the two forms of the total test. This lack of improvement seems to be in line with other reports in the literature concerning vocabulary work not related to a subject-matter field.

A further analysis of the data fails to reveal any significant relationships between the vocabulary scores and other reading factors. First, the initial vocabulary scores on the Nelson-Denny test were correlated with the initial rate scores on the Pressey test, with a resulting coefficient of  $.028 \pm .078$ . They were also correlated with the initial comprehension scores on the Pressey test, the correlation being  $.023 \pm .078$ . A third correlation between the initial vocabulary scores and changes in the comprehension scores on the Pressey tests was even lower, being  $.002 \pm .078$ . The last two measures may not be true indications since the intervals on the Pressey comprehension test were wide, each being 10 per cent, and since the test proved to be too easy to discriminate on these subjects. For example, on the initial Pressey test approximately 35 per cent of the subjects made perfect scores in comprehension, and nearly 70 per cent made not more than one error. Only 14 per cent made more than two errors.



EFFECTS OF REMEDIAL PROGRAM IN TERMS OF INITIAL  
RATE OF READING

The data in Table 4 for the sixty-one subjects in Groups I-III have been regrouped according to rate of reading on the Pressey test at the beginning of the experiment to show the relation between

TABLE 5

MEDIAN GAINS, IN PERCENTAGES, OF RAPID, MEDIUM, AND SLOW READERS IN GROUPS I-III IN (1) SPAN OF RECOGNITION, (2) REDUCTION OF REGRESSIVE MOVEMENTS, (3) SPEED OF RECOGNITION, AND (4) RATE OF READING AS MEASURED BY EYE-MOVEMENT RECORDS

CLASSIFICATION OF READERS AND MATERIAL	NUMBER OF CASES	MEDIAN INITIAL RATE (NUMBER OF WORDS READ PER MINUTE ON PRESSEY TEST)	MEDIAN PERCENTAGE OF GAIN			
			Number of Words Read per Fixation	Number of Words Read per Regression	Number of Fixations per Second	Number of Words Read per Minute
Rapid readers.....	13	469				
Easy material.....			21	133	4	27
Difficult material.....			21	87	5	25
Medium readers....	35	312				
Easy material....			44	112	8	48
Difficult material.....			29	98	10	49
Slow readers.....	13	203				
Easy material.....			21	23	7	28
Difficult material.....			13	38	9	26
All readers.....	61	312				
Easy material.....			30	77	5	34
Difficult material.....			25	87	9	35

the percentage of gain and the initial rate of reading. These reorganized data are presented in Table 5. The rapid group includes all readers whose initial rate was 400 words per minute or more, and the slow section includes all whose initial rate was below 260 words per minute. As shown in Table 5, the median rate of reading for the rapid subjects was 469 words per minute; for the middle group, 312 words per minute; and for the slow readers, 203 words per minute. The following four columns in Table 5 show the median percentages



of improvement, on easy and difficult materials, for span of recognition, reduction of regressive movements, speed of recognition, and rate of reading. As indicated in the medians of the table, the middle group made the highest percentage of improvement in seven of the eight items compared. In speed of recognition the rapid group made much less gain than either of the other two. This smaller gain may be due to the fact that, because duration of fixations for rapid readers is short to begin with, there is less margin for improvement. Although the medium readers gained more than either the rapid or the slow readers, it is important to note that both the rapid and the slow readers made definite gains during the remedial period.

In respect to gain or loss in comprehension measured by the Pressey test, the rapid and the middle groups each made the same median score at the beginning and the end of the experiment, neither gaining nor losing. The slow group of subjects made a median loss of 6 per cent in comprehension. While improvement in comprehension through the remedial program would have been desirable, one must not overlook the fact that a substantial gain in rate with no loss in comprehension is a worth-while achievement. Furthermore, it should be remembered that the comprehension questions on the first half of the Pressey test proved too easy for the subjects in this experiment, more than 35 per cent of them making perfect scores. For this 35 per cent the possibility of improvement in comprehension was automatically excluded. Consequently the comprehension changes are weighted in the direction of loss rather than gain. Five subjects made perfect comprehension scores on both the beginning and the final tests. In such cases a gain of zero obviously does not indicate lack of value in the remedial procedures.

#### INDIVIDUAL VARIATIONS

Initial and final records for each subject have been presented in Tables 3 and 4 in order that a full picture of the effects of the remedial program may be obtained. The program as a whole must be evaluated in terms of median results for the group, but interest in these medians should not detract from concern regarding the nature of gains and losses in individual cases.

On the initial Pressey test the most rapid reader in the group

(Subject 71) read at a rate of 790 words a minute and made a perfect score on the comprehension test, whereas the slowest reader in the group (Subject 75) read at an initial rate of 141 words a minute and made a score of 40 on the first comprehension test. Subject 71 raised her rate on the final Pressey test to 826 words a minute, a gain of 5 per cent. Subject 75, however, increased his speed to 188 words a minute, a gain of 33 per cent. In spite of an apparently satisfactory improvement of 33 per cent, Subject 75 was still reading at a rate which permits vocalization. Observation and conference with him confirmed the fact that he vocalizes word by word as he reads. During the experiment he was never able to increase his speed to the level where vocalization was impossible, while Subject 71 even at the beginning of the experiment read at a rate far beyond the limit of vocalizing. On the initial eye-movement record (Table 4, Section A), Subject 75 made an average of exactly one word per fixation in reading easy material and by the end of the experiment he was able to increase his span of recognition to only 1.3 words per fixation. This subject made a regressive movement for every 6.9 words at the beginning of the experiment and for every 8.5 words at the end of the experiment, whereas for Subject 71 the corresponding number of words per regression were 30.3 and 53.7.

The variation in number of regressive movements (Table 4) was particularly large from subject to subject. For example, at the beginning of the experiment Subject 53 made a regressive movement on the easy material for every 3.2 words and by the end of the experiment was still making one for every 3.7 words, while at the end of the remedial program some subjects were able to read entire selections without any regressive movements.

An examination of the individual records in Table 4 shows lack of uniformity in the gains or the losses in span of recognition, reduction of regressive movements, speed of perception, and rate of reading. For some subjects this inequality seems to be due to unequal development of these factors at the beginning of the experiment, but for others the causes of the inequality are obscure. The variations are sufficient, however, to make it clear that remedial reading needs to be handled on an individual rather than a group basis. It is vir-

tually impossible to find a group of subjects so nearly alike in the factors which were studied that they could be given precisely the same treatment at the same time.

#### RELIABILITY OF GAINS

The significance of the gains in the various factors studied, as indicated by eye-movement records, depends on the reliability of the measurements. As in all other kinds of testing, a certain amount of practice effect on successive eye-movement records may be expected. Practice effect diminishes in proportion to the familiarity with apparatus and technique; that is, the difference between a second test and a first test is affected more by practice than is the difference between a third and a fourth test. The writer attempted to reduce the effects of practice in the eye-movement tests by having the subjects make three readings before the eye-movement camera on three successive days before the initial records for the experiment were taken. Any spurious improvement due to familiarity with apparatus was practically eliminated in this way.

As an additional precaution against incorrect interpretation of eye-movement data, the writer secured a control group of twenty-one subjects at the college level. They read the same selections that were used for the remedial experiment under the same conditions as applied to the regular subjects. The only variations were that in this control group of twenty-one subjects no intervening remedial exercises were given during the month which elapsed between the first and the second reading and no practice with the eye-movement camera was provided before the first record was taken. The results of the eye-movement records for this control group are shown in Table 6, which gives, in group medians, the same types of data which appeared in Table 4 for the subjects of the remedial experiment. As shown in Table 6, there is some practice effect between an initial and a second reading. In span of recognition, as indicated by the average number of words read per fixation, this group of 21 subjects showed a gain on the second reading of 6 per cent on the easy material and of 0 per cent on the difficult material. In average number of words per regression the practice effect was greater, amounting to 23 per cent for easy material and 15 per cent for difficult material.

In speed of recognition, as measured by average number of fixations per second, the practice effect was 2 per cent for both easy and difficult materials. Rate of reading before the eye-movement camera showed an increase of 9 per cent with the easy material and of 4 per cent with the difficult material.

After the third row of data in Table 6 the corresponding percentages of gain for Groups I-III of the remedial subjects are given in

TABLE 6  
COMPARISON, IN GROUP MEDIANS, OF EYE-MOVEMENTS AND RATE OF READING  
OF TWENTY-ONE SUBJECTS ON TWO TESTS TAKEN AT AN INTERVAL  
OF ONE MONTH WITHOUT INTERVENING TRAINING

	AVERAGE NUMBER OF WORDS READ PER FIXATION		AVERAGE NUMBER OF WORDS READ PER REGRESSION		AVERAGE NUMBER OF FIXATIONS PER SECOND		AVERAGE NUMBER OF WORDS READ PER MINUTE	
	Easy Material	Difficult Material	Easy Material	Difficult Material	Easy Material	Difficult Material	Easy Material	Difficult Material
First reading . . . .	1.8	1.7	17.5	14.8	4.4	4.2	489	445
Second reading . . .	1.9	1.7	21.5	17.0	4.5	4.3	531	464
Percentage of gain for con- trol group . . . .	6	0	23	15	2	2	9	4
Percentage of gain for Groups I- III . . . . .	(30)	(25)	(77)	(87)	(5)	(9)	(34)	(35)
Correlation ( <i>r</i> ) between first and second readings . . . . .	.73	.72	.83	.80	.85	.81	.81	.74

parentheses. For example, in span of recognition, as measured by average number of words per fixation, on easy material the control group showed a gain of 6 per cent as compared with 30 per cent for the remedial group; on difficult material there was a gain of 0 per cent as compared with 25 per cent for the remedial group. Other comparisons may be seen by following the third and the fourth rows in Table 6. The differences in favor of the remedial group are actually much greater than appear here because the practice effect exhibited for the control group of subjects would not occur for the regular



subjects in the experiment since they practiced reading with the camera before the initial test was taken.

The last row of figures in Table 6 shows the correlation between the first and the second reading for the twenty-one subjects in the control group. These correlations become higher with successive tests. Again it should be remembered that in the remedial experiment the gains were computed between fourth and later eye-movement records rather than between first and second eye-movement records.

One need not rely entirely on the data from this experiment for facts concerning the reliability of eye-movement records since there are many other sources to draw on. For example, with the split-halves method on material read by 948 subjects from the writer's laboratory, the correlation between average number of fixations in the first and the second halves of a 92-word selection is  $.80 \pm .01$ . Again, the correlation between number of fixations in the reading of two selections of equal difficulty by 164 adults, all of whose education had been limited to the first two years of high school, is  $.84 \pm .02$ . These correlations, furthermore, were obtained from subjects who had had no previous experience with an eye-movement camera.

#### MAINTENANCE OF IMPROVEMENT IN READING

One of the most important questions in regard to a remedial program is whether the results of the program will be fairly permanent or whether they will disappear soon after the remedial program ceases. Table 7 shows the results of retests before the eye-movement camera with as many of the subjects from Groups I, II, and III as could be located just before the writing of this report. Twelve subjects from Group I were retested, 9 from Group II, and 18 from Group III. The interval of time between the remedial experiment and the retest was five months for Group I, four months for Group II, and two months for Group III. The first and third columns of Table 7 show the average percentage of gain during the experiment by these particular subjects; the second and fourth columns show the percentage retained at the time of the maintenance test. On easy material the 12 subjects in Group I made an average gain in average number of words read per fixation of 32.1 per cent. When the main-

tenance test is compared with the initial test, the data show that this group still maintained an improvement of 25.3 per cent, that is, their reading at the time of the maintenance test showed a span of

TABLE 7  
RETESTS OF EYE-MOVEMENTS SHOWING MAINTENANCE IN (1) SPAN OF  
RECOGNITION, (2) REDUCTION OF REGRESSIVE MOVEMENTS  
(3) SPEED OF RECOGNITION, AND (4) RATE OF READING\*

	AVERAGE PERCENTAGE OF GAIN ON EASY MATERIAL		AVERAGE PERCENTAGE OF GAIN ON DIFFICULT MATERIAL	
	During Experiment	At Time of Main- tenance Test	During Experiment	At Time of Main- tenance Test
Average number of words read per fixation:				
Group I.....	32.1	25.3	32.1	41.7
Group II.....	37.0	39.1	31.0	41.1
Group III.....	40.9	31.5	29.2	29.6
Average number of words read per re- gression:				
Group I.....	181.2	88.5	272.3	281.4
Group II.....	224.7	330.2	178.9	267.7
Group III.....	187.5	229.1	178.7	113.7
Average number of fixations per second:				
Group I.....	5.3	5.7	8.1	8.5
Group II.....	8.7	7.4	11.9	7.5
Group III.....	6.5	8.8	8.2	9.8
Average number of words read per minute:				
Group I.....	38.8	32.7	45.1	56.9
Group II.....	49.2	49.7	48.3	51.0
Group III.....	46.0	43.2	38.4	41.8

\* Time intervals between training and retest: for Group I, five months; for Group II, four months; and for Group III, two months.

recognition 25.3 per cent wider than the span of recognition on the test at the beginning of the experiment. In some cases the subjects had continued to improve after the training period, and the scores on their maintenance tests were even higher than those on the final test at the end of the month of remedial work. Comparison of the

percentage maintained with the percentage originally gained indicates a high degree of persistence in the effects of the remedial work. While the time elapsing between the experiment and the retest for Group III was only two months, the time for Group I was long enough to give a fair measure of the effects of the remedial program. The objective data furnished by the tests could be supplemented by many subjective reports of the group members to the effect that their reading was proceeding much more satisfactorily than before the experiment began. In rate of reading it is particularly clear that the subjects gained a technique which permitted a maintenance of a substantial amount of improvement.

#### RELATION OF VISUAL DEFECTS TO IMPROVEMENT IN READING

The subjects in the remedial groups were given visual tests, using the Keystone telebinocular series. According to the standards usually employed with these tests, eighteen of the subjects in Groups I-IV had visual defects of one type or another which would be sufficient to require the services of an eye clinic. Consequently a special examination was made of the reading abilities and gains for this group of subjects.

Table 8 gives the median records of the sixteen subjects in Groups I-III whose tests showed visual defects and for whom remedial treatment was the same compared with the median records of all sixty-one subjects in Groups I-III, whose data were originally given in Tables 3 and 4. Two facts stand out in the table. First, as a group the sixteen subjects were equal or superior to the entire group of subjects in practically every factor measured at the beginning of the experiment. Whatever inconvenience these visual handicaps may have caused, they did not result in a failure to learn to read well. The second fact revealed in the table is that, while this group of sixteen subjects made substantial gains in most of the factors measured, their gains were, in general, smaller than those of the total group of subjects. The differences in gains are really greater than shown by Table 8 because the subjects with visual defects are included in the figures for the total group.

None of the sixteen cases possessed what might be rated as severe

TABLE 8  
COMPARISON OF MEDIANS FOR SIXTEEN SUBJECTS HAVING  
VISUAL DEFECTS WITH MEDIANS FOR  
GROUPS I-III COMBINED

Items Compared	Subjects with Visual Defects	Groups I-III
Rate on Pressey test:		
Initial.....	328	312
Final.....	410	392
Comprehension on Pressey test:		
Initial.....	90	90
Final.....	90	90
Nelson-Denny Reading Test, Vocabulary Section:		
Initial.....	81	76
Final.....	76	76
Number of words read per fixation (easy material):		
Initial.....	1.5	1.4
Final.....	2.0	2.0
Number of words read per fixation (diffi- cult material):		
Initial.....	1.3	1.3
Final.....	1.7	1.7
Number of words read per regression (easy material):		
Initial.....	13.3	12.7
Final.....	21.6	26.8
Number of words read per regression (difficult material):		
Initial.....	7.9	8.2
Final.....	15.5	14.8
Number of fixations per second (easy material):		
Initial.....	4.4	4.4
Final.....	4.7	4.6
Number of fixations per second (diffi- cult material):		
Initial.....	4.2	4.0
Final.....	4.4	4.3
Number of words read per minute on eye- movement tests (easy material):		
Initial.....	407	382
Final.....	536	517
Number of words read per minute on eye- movement tests (difficult material):		
Initial.....	296	295
Final.....	460	429



visual defects. The visual deficiencies were, however, within the range which the telebinocular test would refer to an eye clinic. Without any criticism of the telebinocular test as a means of identifying cases in which vision may be improved, the fact remains that deficiency on this test does not necessarily interfere with reading ability. In this respect the data from the remedial group of subjects is in accord with previous data from the use of the telebinocular test in the writer's laboratory.<sup>1</sup> Good vision is important but it does not necessarily guarantee good reading ability. Neither does the lack of good vision, within rather wide limits, necessarily interfere with the acquisition of satisfactory reading habits.

<sup>1</sup> G. T. Buswell, *How Adults Read*, pp. 104-7. Supplementary Educational Monographs, No. 45. Chicago: Department of Education, University of Chicago, 1937.

## CHAPTER V

### INTERPRETATIONS

THE remedial experiment described in the preceding four chapters had a specific objective, namely, to discover in what manner and to what extent improvement could be made in certain factors which seem to be of major importance in the reading process and whether this improvement could be accomplished by remedial treatment carried on during a series of twenty periods of one hour a day. The five factors were: (1) vocalization, (2) vocabulary, (3) span of recognition, (4) speed of recognition, and (5) regularity of procedure. Since rate of reading is naturally affected by improvement in the preceding factors, some further consideration will be given to it before the five factors are discussed individually.

#### RATE OF READING

Rate of reading is never a primary consideration; it is always secondary to comprehension. This fact should be held firmly in mind throughout the following discussion. No educator would propose that there is virtue in reading rapidly unless the attendant comprehension is satisfactory to the purpose of the reading. On the other hand, it is equally clear that, when comprehension is adequate, the ability to read rapidly is very desirable.

A desirable rate of reading is obviously a function of the purpose of the particular reading being done. Rate should be thought of as one of the most flexible characteristics of reading. Certainly at some times there is every reason to read slowly and with deliberation. In many forms of critical reading, understanding is so much more important than rate that the latter becomes almost insignificant. Rate may likewise be of little importance when enjoyment is the sole aim. Professor Adler,<sup>1</sup> for example, in a recent discussion describes a type of analytical reading which necessitates an exceedingly slow rate and

<sup>1</sup> Mortimer J. Adler, "Reading," *University of Chicago Magazine*, XXX (June, 1938), 10-13.

many repetitions. The writer has no quarrel with this mode of reading. Undoubtedly there are books which should be read repeatedly, analytically, and critically even as his minimum conditions stipulate. The list of such books is probably small as, at the rate required for such reading, it obviously must be. On the other hand, Professor Adler seems to be blind to the fact that most of the reading which is done by the majority of persons and which is suitable for most purposes is of an entirely different kind. He may appropriately raise the question whether extensive rapid reading is worth while. However, many others have considered this same question and have arrived at the conclusion that to read widely is desirable and that, to read widely, one must read rapidly. It is as important to read some types of material rapidly as it is to read other types slowly.

There are other psychological reasons for developing greater rapidity in reading. It is a fact well known to every psychologist that an organism operates most effectively at a rate somewhat below its maximum speed of performance. At its limits, performance becomes erratic and lacking in balance and rhythm. It is commonly accepted that learning should be carried to a level beyond that required by normal experience. A person should learn to read faster than is ordinarily necessary to obtain ease and smoothness in normal reading, much as an automobile needs to be built for a maximum possible speed far exceeding the expected normal cruising rate.

A second principle affecting rate of reading is that reading proceeds most smoothly as it approaches the normal rate of thinking for the type of material at hand. The mind operates with exceeding rapidity in some situations but with great slowness in others. Most persons can easily follow the thread of rapidly moving events as long as their mental reactions are limited to information in regard to the happenings themselves, but, when critical interpretation of events constitutes one's mental experience, the rate of thinking is much slower. Likewise in reading, one may cover the first page of a newspaper with great speed, but the editorial page, at least in some newspapers, produces a much more critical type of reading.

The writer's position in respect to rate may be expressed in the following statements. (1) It is generally desirable to read as rapidly as can be done with understanding. (2) The rate of reading for many

individuals is much below the rate which might become their normal rate for reading with understanding. (3) The reasons for slow rate may vary, but frequently the cause is one of the following: (*a*) a habit of vocalizing while reading silently, (*b*) a narrow span of recognition, (*c*) a slow perceptual reaction time, (*d*) mind-wandering while reading. (4) Increase in rate of reading may be expected if any or all of these factors (*a* to *d*) are improved. (5) Improvement in these factors may be expected in a remedial program which can control the reading process with graduated increases in speed and which provides much reading experience under these controlled conditions.

The remedial experiment described in the foregoing chapters has shown that rate of reading can be improved without loss of comprehension. In 27 of the 61 cases in Groups I-III the improvement accomplished in a month's time, as measured by the Pressey test, was 25 per cent or more. In seven cases the improvement amounted to more than 50 per cent.

The rate of reading of each subject was increased gradually throughout the experiment, for those in Groups I-III by means of the film projector and for Group IV by the beat of a metronome. Throughout the experiment the rate was set at a point slightly more rapid than was comfortable for the subject. This procedure is in accordance with a general principle of learning, namely, that improvement in a habit occurs only when the learner is forced to proceed somewhat beyond his usual rate.

The gradual increase in rate carried with it the necessity for a reduction in vocalization, together with an increase in span of recognition and in speed of recognition. With each increase in the speed of the film projector or the metronome, the subjects experienced some added difficulty in reading. However, it was interesting to note that, during the later part of the twenty days of practice, the speed of reading could be set below the standard for that day but much in advance of the rate at which the subject began practice and the reader would proceed without any feeling of discomfort. This ease of reading along with greater rapidity was the objective of the compulsory increase in speed. The writer is in no sense proposing that persons read constantly at their maximum rate. The purpose of



the experiment was to raise the maximum rate so much that a new habitual rate considerably below this maximum, yet more rapid than the original rate, might be carried on with ease. Some subjects, when practicing with the film projector, were able to read more than seven hundred words per minute with understanding. Such maximum rates will obviously not be maintained, but they permit habitual rates of approximately five hundred words per minute without any feeling of difficulty. The writer would consider a rate of five hundred words per minute not only reasonable but highly satisfactory for the reading of material such as nonfiction books and the better type of magazines. For strictly narrative material many persons without special training read at a rate beyond five hundred words per minute.

The most serious aspect of rate of reading comes from the fact that many persons read at a rate below three hundred words per minute on material that is simple in form, straightforward in meaning, and without any possibilities of critical interpretation or search for hidden thought. An announcement of the date, place, and time of a meeting, for example, can be read rapidly, yet many persons do not read it thus. Likewise, a descriptive account of an event may be read rapidly, but many persons read such material slowly. They read slowly because their span of recognition is narrow and they give attention to every word instead of to the ideas in the paragraph. They react slowly with their eyes and do not proceed evenly along the lines of print. These slow and cumbersome habits do not aid in securing clearness of meaning from what is read; rather they interfere with the acquisition of meaning. Muscular effort, with consequent fatigue far beyond that felt by an efficient reader, is made necessary. Such inefficient readers frequently delude themselves by confusing immature perceptual habits in reading with "careful reading." Data are abundant to show that normally rapid readers have better comprehension than normally slow readers; yet, when one proposes more rapid reading, a common reaction is to deprecate its importance or to claim that rapid reading may even be undesirable since it might interfere with comprehension. Such statements are refuted by all the facts in the case.

## VOCALIZATION

Degrees of vocalization range all the way from oral reading to silent reading in which vocalization is so slight that delicate laboratory instruments are required to detect it. In some cases there appears to be no evidence at all of vocalization during silent reading.

Vocalization has certain values and, under the stress of major difficulties in interpretation, may even be found helpful. Nevertheless, where no special difficulties in comprehension appear, vocalization is a hindrance rather than an aid to good reading. It retards the rate of reading to that of speech and places attention on word units rather than on units of thought. Persons who have always vocalized find it difficult to conceive that reading can be done in any other way than by saying words.

The present experiment relied on speed as the chief means of breaking down vocalization. The majority of the subjects were not troubled with this fault since in their initial tests they read silently at a rate beyond the limits of vocalization. For the slower readers, that is, for those whose initial rate was below 250 words per minute, the tendency to vocalize constituted a major obstacle to improvement in reading. If pressure for rapid reading was applied in too great amount, they were utterly incapable of getting any meaning from what was read. Pressure, gradually increased, carried a number of the subjects beyond the limits of vocalization. When vocalization did stop, the cessation seemed to occur suddenly and to be accompanied by an awareness on the part of the reader that he had made an adjustment to speed without knowing exactly how he had made it. There were some cases, however, in which the remedial techniques were not adequate to eliminate the tendency to vocalize. Evidently the habit of vocalization had been so firmly fixed that to these subjects it seemed inherent in all reading.

## VOCABULARY

The problem of improving vocabulary is complex. On the one hand, it consists in the development of familiarity with more words. This type of development requires a breadth of experience commensurate with the new words which are learned. On the other hand, vocabulary development consists in an intensive study of forms of

words and variations in meanings. This approach has received less attention in the literature of reading than has the development of an extensive vocabulary.

The vocabulary exercises employed in the remedial experiment did not produce any improvement which could be measured by the test used. It may be that there was no improvement, that the test employed was concerned more with extensive vocabulary than with intensive development, or that a longer time than one month is needed to make any notable change in vocabulary. Regardless of causes, the fact remains that the median vocabulary score for the group was the same at the end as at the beginning of the experiment. The techniques relating to vocabulary will need to be modified and tried again.

#### SPAN OF RECOGNITION

There was a time in American schools when reading was taught by beginning with the alphabet, then proceeding to two-letter combinations, then to combinations of three, four, and five letters. When letter combinations were mastered, combinations of short words were introduced, and gradually combinations of longer words or sentences were added. Much time in the early stages of teaching was given to combinations of words which did not make sentences and which conveyed no coherent ideas. Examples of this mode of teaching may be found in widely used textbooks published about the year 1800.

An understanding of the psychology of reading has proceeded a long way since 1800. One of the most important findings is that effective perception deals with large patterns rather than small details. Applied to reading, this principle means that effective reading instruction does not direct the child's attention to letters and words but to units of meaning. A word is a perceptual pattern which can be recognized even before a child learns all the letters. Likewise, phrases present units of meaning recognizable without attention to the individual words. The import of a paragraph is found not by summing together the meanings of the individual words which constitute it but rather by fusing the meanings of the words into units of thought dependent on word arrangement as much as on word meaning.

By calling attention to the importance of larger perceptual units in reading, psychology has contributed a new methodology to its teaching. Under the old word method, for which oral reading was largely responsible, children developed an ability to pronounce words but often failed to develop equal ability to understand meanings. Present methods of teaching reading attempt to produce as wide a span of recognition as possible. The curves of growth for this factor have been plotted objectively and are well known. Good readers have attained a broad span of recognition by the end of the sixth grade of the elementary school; other readers let their reading habits crystallize at a point where a narrow span of recognition becomes a permanent characteristic. A narrow span not only necessitates slow reading but emphasizes attention to the form of words and sentences, a rapid acquisition of meaning being thereby blocked.

The data from this experiment have indicated clearly that a wider span of recognition can be developed by the remedial methods used. This result was accomplished by forcing reading into a mold where a wider span was necessary if the subject were to read at all. The eye-movement records provide an objective check of this development of a wider span of recognition, and the maintenance test shows that the major part of the gain persists, at least for some months, after the end of the remedial period.

The width of the span of recognition becomes habitual with a reader. The subjects in this experiment were adults whose habits of recognition were more firmly fixed than is usual among pupils in the upper grades of the elementary school or in the high school. With sufficient pressure the narrow span was broken down, even with these adult readers, and a wider pattern of perception was substituted. It should be noted that special pressure was required. These adults had been reading for years and had not improved their reading; rather they had habitualized it at a level much below their possibilities. As in most types of perceptual learning, progress required pressure and concentration. The remedial experiment has made clear that it is possible to accomplish significant gains by the methods used.



## SPEED OF RECOGNITION

The data from the remedial groups show that speed of recognition can be increased but not to any great extent. As measured by increase in the number of fixations per second, the percentages of gain were smaller than those for the other factors studied. However, a decrease in average duration of fixation pauses by even a small amount can be a definite aid to reading, particularly in view of the fact that it is not compensated for by an increase in the number of fixations.

Variations in duration of fixations were large, both from individual to individual and from fixation to fixation for the same individual. Long fixations occurred where there were difficulties either in thought or in recognition of words. Consequently improvement in vocabulary and in general familiarity with word forms helps to reduce fixation time. Within a field with which the reader is familiar, speed of recognition is greater than in unfamiliar fields; in this respect quicker recognition is facilitated by breadth of general education. In addition, there is an opportunity to increase the speed of recognition by practice in recognizing quickly more common words and groups of words. The remedial program has shown that there are possibilities of improvement through the use of the techniques employed.

## REGULARITY OF PROCEDURE IN READING

A reasonable degree of regularity in proceeding along the lines of print is a valid objective in teaching reading. This objective does not mean precise mathematical regularity from line to line but rather means an avoidance of the spasmodic fluctuations which characterize the reading of many slow readers. There are several causes for these fluctuations. One of the major causes is lack of familiarity with vocabulary or with the ideas making up the content of the material. These deficiencies make necessary a considerable amount of re-examination of the material, and frequent regressive movements will be noted. However, irregularity may be caused in other ways, one of the most common causes being mind-wandering or lack of attention to what is read. Symptoms of this form of behavior are

a slowing-down of the reading process, longer fixations, and more fixations than occur when the person reads with concentration. To be sure, there are legitimate reasons for variations in rate of reading and, when these exist, there is no disposition to criticize appropriate irregularity. Legitimate causes of irregularity in procedure should not, however, obscure the fact that in many cases there is an extreme degree of irregularity which is completely unjustified.

The most useful objective measure of irregularity is the frequency of regressive movements. As indicated by the tables presented in chapter iv, the remedial procedures were particularly successful in assisting the subjects to read with increasingly fewer regressions. In some cases regressive movements were almost eliminated. The film projector is particularly well adapted to this end because the material in view disappears as the succeeding part of the line is exposed. Further evidence of increase in regularity is available from the records of eye-movements on successive lines of reading, where an examination shows that the most competent readers were able to set up perceptual habits of reading line after line quite uniformly with three or four fixations per line. This establishment of a pattern of rhythmic procedure across the lines of print is evidence of a mastery of the process of reading which practically eliminates all difficulties other than those relating to the thought of the material read.

Where careful analysis characterizes the reading process, regressive movements are not undesirable; they are unavoidable accompaniments of the necessary re-examination of material. However, it is impossible to excuse them in the noncritical reading which makes up most of the reading for the majority of persons. Educators are likely to overestimate greatly the proportion of critical reading done by the great mass of readers. Academic minds might even profit by a flexible reading ability which would permit more rapid reading of larger amounts of material purely for enjoyment or for information.

#### SUMMARY

The remedial experiment here reported has attempted to find out how to improve reading by attacking specific factors known to be important to the reading process. Improvement in these factors was

brought about by controlling the reading done by a subject for a given period of time. The objective measures applied to the results of the remedial techniques indicate that a large degree of improvement was obtained. Furthermore, the total amount of time devoted to this experiment was reasonably short, and more improvement might be expected if the time should be somewhat increased.

The facts to be emphasized are that the remedial techniques were simple and direct, that the experiment aimed at specific objectives, and that it avoided completely a great mass of trivial techniques which only confuse a remedial program.

A remedial program should never be confused with a developmental program. A school should never pride itself on the extent of its remedial program; rather it should call attention to the degree in which corrective work is not needed. The principal contribution of a remedial program is to overcome crudities in the process of reading which the regular developmental program has failed to eliminate. A remedial program is more properly concerned with process than with content.

In the experiment reported here, the gains secured were in the reading process rather than in comprehension. The reader should remember that the subjects in this experiment were college students and adults whose comprehension scores, even at the beginning of the experiment, were reasonably satisfactory. Their difficulty was not primarily in understanding what was read but rather in inability to read with reasonable speed. The experiment was chiefly concerned with improving their process of reading on materials within their range of comprehension. This purpose, it seems to the writer, should be the basic aim of any remedial program. When a remedial program attempts to go much beyond this purpose, it ceases to be a remedial program and becomes more properly a developmental program. Furthermore, when the term "reading" is used to indicate more than the developing of an ability to read, with reasonable speed and comprehension, materials within the range of the reader's experience the term tends to become synonymous with the term "education" and ceases to have any usable meaning.

There is no doubt that at the present time remedial reading is being grossly exploited. It is being exploited, on the one hand, by overambitious programs which come from within the school itself. On the other hand, it is being exploited by commercial concerns who are loading public schools with expensive apparatus which is impressive only to the uninformed and which is being emphasized out of all proportion to its actual value in a practical remedial program. Some clear thinking is needed to prevent remedial programs from outweighing developmental programs.



## CHAPTER VI

### EXTENSIONS OF THE STUDY

**D**URING the latter part of the study reported in the previous chapters, two extensions of technique were set up. Although these were used with a small group of subjects, there was not sufficient time to gather enough data to warrant reporting them in this monograph. However, a brief description will be given of the two techniques, since they seem to promise something of value for research in reading. Further experimentation must be carried on before a detailed report is warranted.

#### A SIMPLE DEVICE FOR CONTROLLING READING

The film projector which was used in this study proved to be of value in widening the span of recognition, in reducing the duration of fixation pauses, in producing greater regularity in reading, and in improving rate of reading. It can be manufactured at reasonable expense, and the cost of film is not prohibitive. However, the cost will be too great to permit use by many schools, and the fact that it must be used in a darkened room presents a practical difficulty.

The writer's interest in developing a film projector was partly stimulated by the desire to make this technique available at less expense than is involved in the purchase of the larger mechanical devices already on the market. Although the film projector reduces the expense of such equipment to approximately one-third the cost of mechanically operated flash devices, a still further simplification of the apparatus would be desirable. Consequently a very simple form of apparatus, shown in Plate VII, was built and tried with a small group of subjects. This apparatus consists of a Leich motor, such as is used in an electric clock, and a series of gears which move a lightweight aluminum cover over a page of print so that the successive lines are covered at a predetermined rate. By the shifting of the series of ten gears from left to right, the print on a page may be covered at rates varying from 150 words per minute to 650 words per

minute. Still greater variations can be obtained by increasing the number of gears on the motor shaft. The reading situation is similar to that frequently encountered in the movies when a page of print gradually unrolls itself on the screen. This apparatus differs in that the page of print remains still while the aluminum plate passes down over it, whereas in the movies the print ordinarily is made to move up and disappear at the top of the screen.

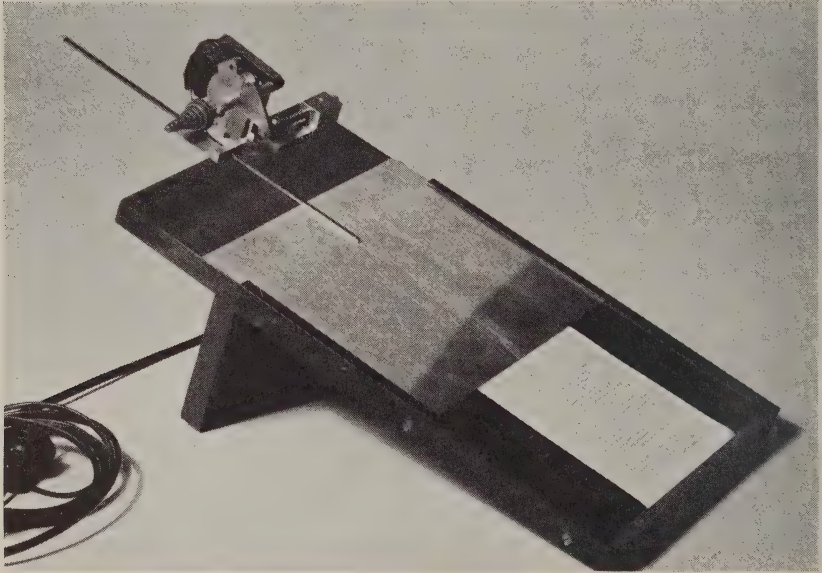


PLATE VII.—Apparatus for covering reading material at a controlled rate

The purpose of the device just described is to control the rate of reading in such a way that two things may be accomplished: First, the reader is forced to make constant progress at a fixed rate, mind-wandering and irregularity in his reading being thereby eliminated. Second, the rate of covering the page may be so controlled that a reader can be pushed slightly faster than his habitual rate of reading. This pushing process can be continued day after day as the subject learns to adapt himself to more and more rapid reading. The situation is somewhat more normal than in the film projector since the breaking of lines of print into thirds constitutes an artificial and temporarily disturbing interruption of the material to be read.

A further advantage of the new device is that any printed material may be used with it by simply inserting the successive pages to be read under the aluminum cover plate. The cost of the material is thereby made inconsequential and the apparatus itself can be built for approximately fifteen dollars. It can be plugged into any standard electric outlet and operates noiselessly.

Four subjects used the apparatus approximately forty minutes a day for ten days. One of the subjects started at a rate of 240 words a minute and at the end was reading with satisfactory comprehension at 320 words a minute. Two of the subjects began at 400 words a minute and at the end of the ten-day period were reading 640 words a minute. The remaining subject began at 400 words a minute and at the end of the ten-day period was reading 600 words per minute. When tested without the use of the apparatus, their rates of reading dropped back somewhat as compared with their rates under pressure. The practice period quite clearly was not sufficient to establish a new habit of reading firmly enough to transfer to the normal situation without the use of apparatus.

Further experimentation will be needed to determine the length of time required to modify one's reading habits permanently by this method; no generalizations are warranted on the experience of four cases for so short a time as ten days. The apparatus will receive further testing, and the results will be reported later. The apparatus cannot be recommended for general practice in remedial classes on the basis of the limited use given it. However, the underlying hypotheses warrant further trial of this apparatus in situations where an experiment can be organized.

#### AN EXPERIMENT IN DETECTING VOCALIZATION

There is general agreement that vocalization is an important factor affecting reading ability. Early in the experiment means were sought for securing an objective record of subvocal tendencies. Because tambours against the throat do not provide a sufficiently delicate index of tendencies to vocalize, the writer sought some means of amplifying the muscular movements in the vocal-cord area.

The apparatus finally decided upon was that which is used for making electroencephalograph records, described in popular ter-

minology as a "brain-wave apparatus." The necessary equipment was constructed in the shops of the Department of Physiology of the University of Chicago and was installed in the Psychology Laboratories of the Department of Education. Six months were required for constructing the apparatus, and experimentation was further delayed when it was found necessary to shield the equipment from electrical disturbances with a metal floor and a copper-screen housing.

The initial experiment was concerned with identifying the difference in the alpha brain wave when reading orally and when reading silently. Some time was used in determining experimentally the best positions in which to place the electrodes in order to secure good records. Further time was expended in determining the best methods of obtaining objective and reliable measures of the variations in the waves. Finally, it became clear that an adequate body of evidence could not be secured and interpreted without delaying the report of the other parts of the study for another year. For this reason no attempt is made to present a body of data employing the brain-wave technique.

In the process of experimenting with vocalization other problems emerged which may prove to be of even more importance than the problem of vocalization. For example, there seems reason to believe that the brain-wave recordings may make it possible to distinguish the type of reading which is done with concentration and the type of reading in which the mind wanders and little thought is given to the material read. An objective distinction of degrees of mental effort would prove to be so important for reading that, if found to be reliable, the use of such a technique opens up a wide field for study.

The use of the brain-wave apparatus in studying reading is reported here simply to record the fact that such apparatus is available and that a start on applying it to problems of reading is being made. In the writer's opinion, several years may pass before difficulties in techniques can be sufficiently mastered to find out just what possibilities this method holds for studying problems of reading. The technique may prove to be a false lead, but it may give some insight into the nature of reading which has so far escaped observation. A new technique is sometimes the key to a new body of understanding.



## INDEX

- "Achievements of Civilization," 31
- Adams, James Truslow, 4
- Adler, Mortimer J., 56
- American Council on Education, 31
- Analysis, 8
- Apparatus, 12, 19, 30, 41, 67, 69
- Average reading, 11, 57, 64; *see also* Medium readers
- Brain-wave apparatus, 70
- Buckingham, B. R., 18
- Bush, Wendell T., 5
- Buswell, G. T., 16, 55
- Chicago Daily News*, 4
- "Children's Bookshelf, The," 18
- Clark, William L., Jr., 5
- Comprehension, 11, 18, 29, 34, 35-36, 40, 41, 47, 56
- Concentration in reading, 29, 70
- Connotation of a word, 10
- Control group, 16, 49
- Controlled reading, 27, 30, 43, 58, 67, 68
- Cost of remedial equipment, 25, 67
- Cover-up device, 67
- Developmental program, 65
- Duration of fixations, 13, 41, 47, 63
- Exploitation of remedial reading, 1, 12, 66
- Extensions of study, 67
- Eye-movements: objectivity of, 10, 12, 19, 49, 51, 62; photographing of, 27, 29, 31; records of, 37-40, 41, 46, 48, 50, 52, 54
- Factors: basic to reading process, 3, 8; specific, of study, 8, 43, 56, 64
- Fixations: 28, 51; per second, 37-40, 41, 46, 50, 52, 63
- Flexibility in reading, 6, 9, 29
- Gates, A. I., 10
- Habits of reading, 3, 6, 62, 69
- How Adults Read*, 16, 55
- Individual procedure, 16, 27, 42, 45
- Individual variations, 16, 47
- Integration, 8
- Interpretations, 56
- Iowa Every-Pupil Test of Basic Skills, Test A, Silent Reading Comprehension, 31, 32, 33
- Kennedy, Helen, 18
- Keystone telebinocular, 18, 31, 53
- Literature on remedial reading, 1, 12
- Maintenance of improvement, 51, 52
- "Mechanics" of reading, 2, 12
- Medium readers, 46
- Metronome, 17, 27, 28, 34, 40, 42
- Millay, Edna St. Vincent, 5
- Mind-wandering, 2, 9, 14, 15, 58, 63, 70
- Nelson-Denny Reading Test for Colleges and Senior High Schools, 18, 45, 54
- Objectives of experiment, 8, 56, 65
- Objectives of reading, 7, 11, 29, 30, 63
- Perceptual process, 3, 7, 11, 30, 61
- Physiological exercises, 12
- Poetry, 19, 28
- Preliminary groups, 17, 31
- Pressey Test of Reading Speed and Comprehension, 18, 34, 35-36, 40, 42, 43, 46, 47, 54, 58
- Problem defined, 2
- Projector: development of, 19, 23, 67; materials for, 19, 26, 31, 33; practice with, 27, 30, 31, 32, 43, 64
- Rapid reading, 11, 14, 16, 28, 46, 48, 59
- Rate of reading, 13, 29, 35-36, 37-40, 41, 42, 43, 46, 48, 50, 52, 53, 56
- Regressive movements, 15, 30, 32, 37-40, 41, 42, 43, 46, 48, 49, 52, 63
- Regularity of procedure in reading, 14, 29, 41, 42, 63
- Reliability of gains, 49
- Remedial experiment, 16
- Results: with final experimental groups, 34; permanence of, 51; of preliminary experiments, 31

- Samples of types of reading, 4, 5  
 Schedule for subjects, 16, 27, 49  
 Selections: for eye-movement photographs, 20, 21, 22, 31, 32, 33, 41; for practice, 17, 26  
 Slow reading, 9, 14, 46, 48, 58, 59, 63  
 Span of recognition, 11, 30, 32, 37-40, 41, 42, 43, 46, 48, 49, 50, 52, 58  
 Speed of recognition, 13, 32, 37-40, 41, 42, 43, 46, 48, 50, 52, 58, 63  
 Strang, Ruth, 32  
*Study Type of Reading Exercises*, 32  
 Subjects, 3, 16, 17, 31, 32, 34, 69; retested, 51; with visual defects, 53, 54  
 Summary, 64  
*Teacher's Word Book, The*, 25  
 Technique of investigation, 8  
 Tests, 18, 27; maintenance, 52  
 Thorndike, Edward L., 10, 25  
 Time: dates, 17, 51; limitations, 3; used in study, 16, 27, 45, 51, 53  
 Types of reading: dealt with here, 4, 6; suited to circumstances, 3, 43, 56, 64  
 Visual defects, 12, 53, 54  
 Vocabulary, 10, 33, 43, 60, 63  
 Vocalization, 9, 29, 48, 58, 60, 69  
 Words read: per fixation, 37-40, 41, 46, 50, 52; per minute, 35-36, 37-40, 41, 46, 50, 52; per regression, 37-40, 41, 46, 50, 52



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